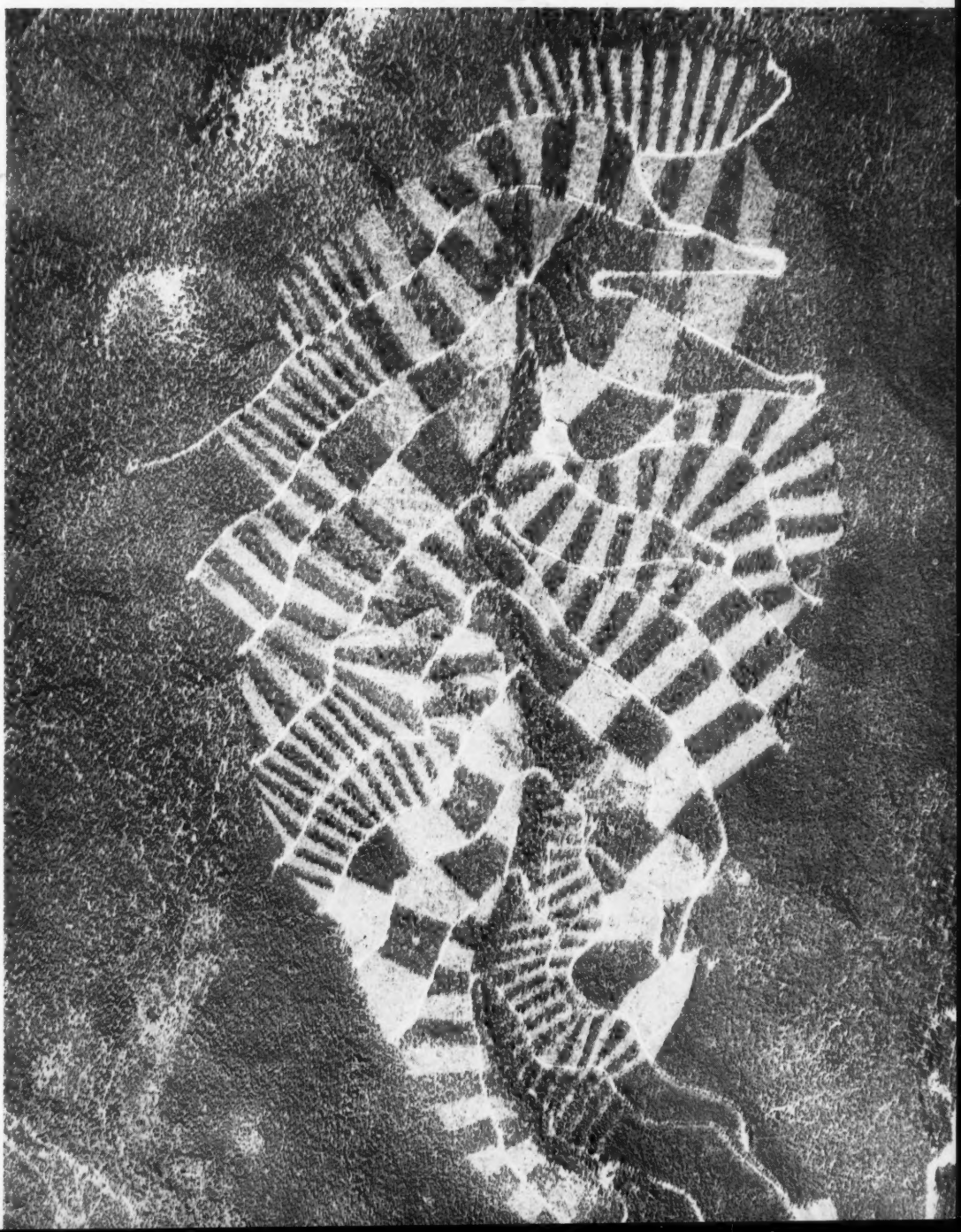
Journal of FORESTRY

March 1958



SOCIETY OF AMERICAN FORESTERS 1900

Volume 56
Number 3

For a Well Balanced Fire Prevention Program

YOU NEED

INDIAN

FIRE PUMPS

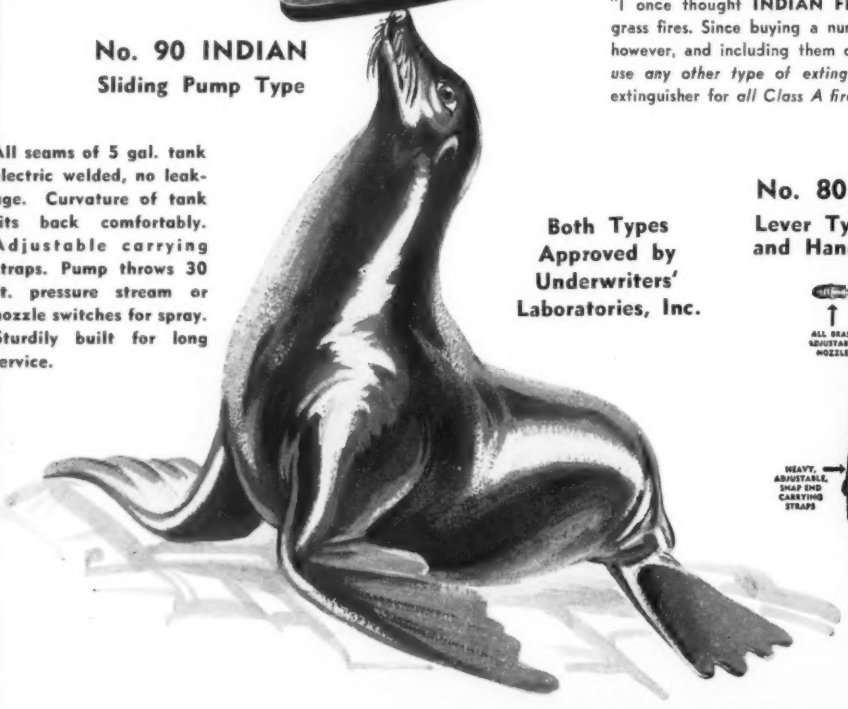
Fire fighters call them a "ONE MAN FIRE DEPARTMENT"

Round out your equipment with an ample supply of INDIANS "the pump of 100 uses." Here's what Fire Chief G. P. Lasher says about them:

"I once thought **INDIAN FIRE PUMPS** had use only for putting out grass fires. Since buying a number of No. 90 solid brass tank **INDIANS,** however, and including them on our apparatus I found *the men would not use any other type of extinguisher.* We prefer them to any other hand extinguisher for *all Class A fires* and small oil fires."

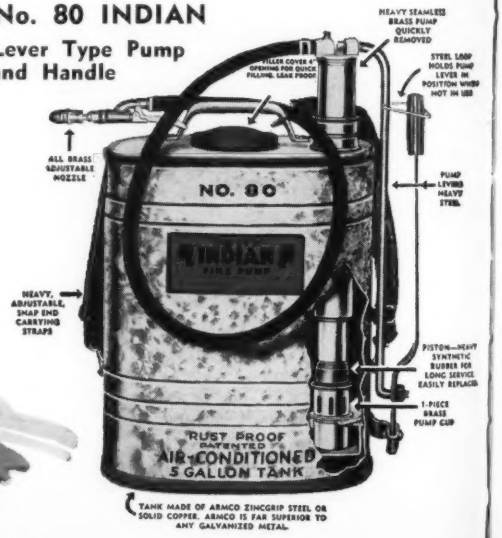
No. 90 INDIAN
Sliding Pump Type

All seams of 5 gal. tank electric welded, no leakage. Curvature of tank fits back comfortably. Adjustable carrying straps. Pump throws 30 ft. pressure stream or nozzle switches for spray. Sturdily built for long service.



Both Types Approved by Underwriters' Laboratories, Inc.

No. 80 INDIAN
Lever Type Pump and Handle


HEAVY SEAMLESS BRASS PUMP QUICKLY REMOVED
STEEL LOOP HOLDS PUMP LEVER IN POSITION WHEN NOT IN USE
ALL BRASS ADJUSTABLE NOZZLE
PUMP LEVER HEAVY STEEL
NO. 80
INDIAN
FIRE PUMP
HEAVY, ADJUSTABLE, SNAP END CARRYING STRAPS
PISTON—HEAVY SYNTHETIC RUBBER FOR LONG SERVICE EASILY REPLACED
1-PIECE BRASS PUMP CUP
RUST PROOF
PATENTED
AIR-CONDITIONED
5 GALLON TANK
TANK MADE OF ARMCO ZINCGRIP STEEL OR SOLID COPPER. ARMCO IS FAR SUPERIOR TO ANY GALVANIZED METAL.

Send for Our New Catalog

D. B. SMITH & CO. "FOR SEVENTY YEARS THE LEADERS" **407 Main St., Utica 2, N. Y.**

Pacific Coast Branches:

Hercules Equipment & Rubber Co., Inc. San Francisco 7, Calif. — Halprin Supply Co. Los Angeles 15, Calif. — Fred E. Barnett Co. Portland, Ore. — Fred E. Barnett Co. Klamath Falls, Ore. — Mill & Mine Supply Inc. Seattle 4, Wash. — L. M. Curtis & Sons Salt Lake City, Utah

Canadian Agents: Fleck Bros. Ltd. Vancouver, B. C. — C. E. Hickey & Son, Hamilton, Canada — Bisson Hardware Co. Toronto, Canada

VOLUME 56 • NUMBER 3 MARCH 1958

Journal of Forestry

Editorial Staff

ARTHUR B. MEYER ..... *Editor*

HENRY CLEPPER ..... *Managing Editor*

L. AUDREY WARREN ..... *Business Manager*

Associate Editors

R. KEITH ARNOLD, *Forest Fire*, California Forest and Range Experiment Station, P. O. Box 245, Berkeley 1, Calif.

JAMES S. BETHEL, *Forest and Wood Utilization*, School of Forestry, North Carolina State College, Raleigh, N. C.

C. ALLEN BICKFORD, *Mensuration*, Northeastern Forest Experiment Station, 102 Motors Avenue, Upper Darby, Pa.

ROBERT E. DILS, *Watershed Management*, School of Natural Resources, University of Michigan, Ann Arbor, Mich.

JOHN W. DUFFIELD, *Silviculture*, Col. W. B. Greeley Forest Nursery, Nisqually, Wash.

LEE M. JAMES, *Forest Economics and Policy*, Department of Forestry, Michigan State University, East Lansing, Mich.

HARVEY J. MACALONEY, *Forest Pathology and Entomology*, Lake States Forest Experiment Station, St. Paul Campus, University of Minnesota, St. Paul 1, Minn.

CHARLES E. POULTON, *Range Management*, Withycombe Hall 302, Oregon State College, Corvallis, Ore.

GEORGE H. SCHROEDER, *Forest Management and Engineering*, Crown Zellerbach Corporation, Public Service Building, Portland 4, Ore.

PHILIP C. WAKELEY, *Forest Genetics and Artificial Regeneration*, Southern Forest Experiment Station, 704 Lowich Building, 2026 St. Charles Avenue, New Orleans 13, La.

LEE E. YEAGER, *Forest-Wildlife Management and Recreation*, Colorado Cooperative Wildlife Research Unit, 243 Forestry Building, Colorado State University, Fort Collins, Colo.

LLOYD THORPE, *Advertising Representative*, 212 General Insurance Building, Seattle 5, Wash.

The JOURNAL OF FORESTRY, established in 1917, is the official organ of the Society of American Foresters, but the Society assumes no responsibility for the statements and opinions expressed by contributors.

Publication office, 425 Mills Building, 17th Street at Pennsylvania Avenue N. W., Washington 6, D. C. Address all correspondence concerning editorial or business matters to JOURNAL OF FORESTRY, 425 Mills Building, 17th Street at Pennsylvania Avenue N. W., Washington 6, D. C. Published monthly. Subscription $7.50 per year; single copies 75 cents. Missing numbers will be replaced without charge provided claim is made within thirty days after date of the following issue.

The editors are not responsible for loss or damage of manuscripts and photographs while in transit or in their possession. All material submitted for publication should be accompanied by return postage.

Copyright, 1958, by the Society of American Foresters. Entered as second-class matter at the post office at Washington, D. C. Acceptance for mailing at the special rate of postage provided for in the Act of February 28, 1925, embodied in Paragraph 4, Section 412, P. L. and R. authorized November 10, 1927.

CONTENTS

COVER: Cutting patterns created in a dual timber and watershed management test on the Fraser Experimental Forest, Colorado.
Photo courtesy U. S. Forest Service

The Trend of Lumber Prices ..... *Joseph Zaremba* 179

A Test of Group Selection in Idaho Ponderosa Pine *James D. Curtis* and *Alvin K. Wilson* 182

Control of the Turpentine Beetle in Naval Stores Stands by Spraying Attacked Trees with Benzene Hexachloride ..... *R. H. Smith* 190

Sodium Arsenite in Spaced Ax Cuts: an Effective Stand-Improvement Technique
Francis M. Rushmore 195

Observation Limits for Aerial Sketch-Mapping Southern Pine Beetle Damage in the Southern Appalachians
R. C. Aldrich, R. C. Heller, and *W. F. Bailey* 200

Some Effects of Thinning a Ponderosa Pine Thicket with a Prescribed Fire
William G. Morris and *Edwin L. Mowat* 203

Construction of Cubic-Foot Volume Tables for Red Oak in Pennsylvania
Thomas W. Beers and *Samuel F. Gingrich* 210

Effect of Soil Amendments on Growth of Shortleaf Pine
Elmer R. Roth and *Thomas C. Evans* 215

Notes 217
Deep Girdles Give Quickest Crown Kill of Oaks; Variation of Sampling Precision with Merchantability Classes in Relascope Estimates of Basal Area; Wound Area as Influenced By Closeness of Pruning; Incidence of Heart Rot in Mature Loblolly Pine in Coastal North Carolina.

Points of View 222
Basic Research—What is it?; More on Basic Research.

Reviews 224
The Federal Lands, Their Use and Management; British Commonwealth Forest Terminology Part II—Forest Products Research Extraction, Utilization, and Trade; The Experimental Control of Plant Growth; River Basin Development; Economics of Under-Developed Countries; Publications of Interest.

Current Literature 228

Society Affairs 230

Forestry News 250

Index to Advertisers 256

MOTOROLA 2-WAY RADIO COSTS YOU NOTHING

With 2-way radio, the logging superintendent is in immediate touch with each of his key personnel all day long. Problems in safety, personnel welfare, breakdown, landing clog-ups, supervisory decisions and forest protection can be handled on the spot. If each mobile unit saves only two minutes an hour, Motorola radio pays for itself. And in times of emergency, the 2-way radio is invaluable.

Add up the benefits yourself. You'll see why Motorola 2-way radio actually makes money for you. Why delay any longer? Contact Motorola today.

IF YOUR DRIVER SAVES 2 MINUTES AN HOUR WITH RADIO

HERE'S THE PROOF

Even if your cost is as low as $5.00 an hour . . . $3.00 for the truck and $2.00 for the driver . . . saving as little as 2 minutes an hour* for each radio-equipped truck will more than pay for your Motorola 2-way radio system, including installation and maintenance. And after three years, the system is all yours!

*Based on ultra-conservative three year amortization schedule.

MOTOROLA *2-WAY RADIO*

MOTOROLA COMMUNICATIONS & ELECTRONICS, INC. • A Subsidiary of Motorola, Inc. • 4501 Augusta Blvd. • Chicago 51, Illinois

Journal of Forestry

Official Organ of the Society of American Foresters

The Trend of Lumber Prices[1]

Joseph Zaremba
State University College of Forestry
at Syracuse University,
Syracuse, New York

THE RISING TREND of lumber prices in the United States has been a subject of serious discussion for many years. The fear has been frequently expressed that continued increases in lumber prices at the past rate would place the lumber industry in a progressively weaker position with respect to the manufacturers of competing materials.

Various writers have attempted to explain the cause of the rising trend of lumber prices by conditions limited exclusively to the lumber industry. Compton in 1916 (*3*) and Bryant in 1919 (*1*), who were among the first to note an upward trend of lumber relative to all-commodity prices, suggested that the phenomenon was due to the gradual shifting of the center of lumber production away from the lumber-consuming centers in the East. Both Foster (*7*) and Hall (*8*) in 1946 recognized that the low efficiency of lumber mills was partially responsible for high lumber prices after World War II.

Notwithstanding the contributions of previous writers, the nature of the forces underlying the trend of lumber prices is yet to be fully explained. The purpose of this article is to show that these forces are rooted in certain relationships which exist between the lumber industry and the rest of the economy rather than in conditions limited to the lumber industry.

Trend of Lumber and of All-Commodity Prices

The wholesale-price index of lumber in the United States from 1860 to 1955 is depicted in Figure 1 along with the wholesale-price index of all commodities. The latter has been relatively stable throughout this period. Apparently, in the long run, the American economy produces the goods and services demanded by consumers at fairly constant money prices.

Lumber prices have followed roughly a 3-percent trend line. They have steadily departed from all-commodity prices. This departure has been particularly rapid since 1900. During the depression of the 1930's, when the lumber industry as a whole operated at a loss, the price of lumber did not decline to the previous low points of 1908 and 1915. Thus, despite a powerful downward pressure on lumber prices exerted by declining lumber demand, lumber prices remained at a relatively high level throughout the 1930's. Apparently the lumber industry produces lumber only at steadily rising prices. Why is this so?

Relationship Between Price and Average Cost of Production

Variations in lumber prices, like variations in the prices of all commodities produced under competitive conditions, are caused by different factors according to the length of time under investigation. Price variations within a short interval are caused mainly by demand factors such as consumer income and the number of houses under construction. The longer the period under investigation, the greater is the share of attention that must be given to the influence of the cost of production on price (*10*). This analysis is concerned with price variations over a period of almost a century. Consequently, the emphasis here is on the influence of the cost of production on lumber prices.

The trend of lumber prices will parallel the trend of the average costs of producing lumber since in

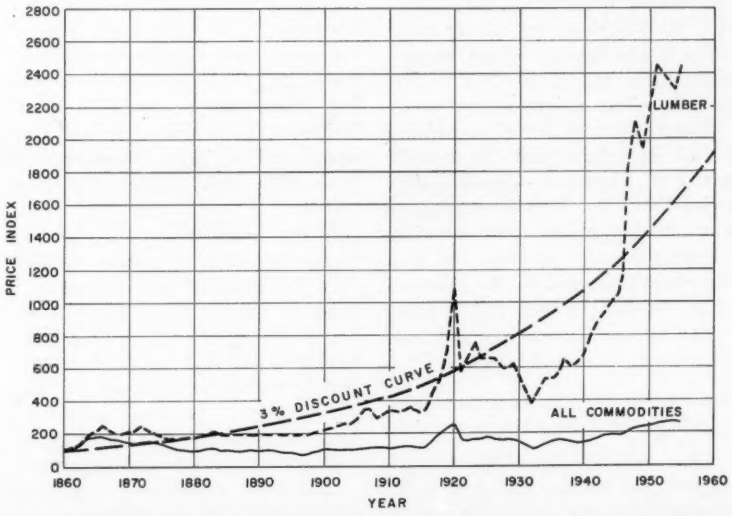


FIG. 1.—Wholesale price indices for lumber and all commodities, 1860-1955. (1860=100.) (These indices up to 1947 were obtained from the following sources: James, L. M., 1947. The trend of lumber prices. Jour. Forestry 45:646. All-commodity and lumber prices since 1947 were obtained from U. S. Bur. Labor Statis., *Monthly Labor Review*.)

[1]The writer is indebted for help and criticism to William A. Duerr, State University of New York, and to G. Orcutt, Harvard University. Any mistakes remain the responsibility of the writer.

the long run prices must cover the average costs of production. Thus the divergence of the trend of lumber prices from all-commodity prices in Figure 1 represents, at the same time, the divergence of the cost structure of the lumber industry from the cost structure of the economy. While the cost structure of the economy has remained stable in terms of money prices the cost structure of the lumber industry has moved upward.

The central question now becomes clearer: Why has there been a rise in the cost structure of the lumber industry relative to the cost structure of the whole economy?

The answer to this question might seem obvious. The overriding cost item in the lumber industry is the cost of labor. Stumpage, of course, is a cost, and its rapid rise in recent years has undoubtedly put pressure on lumber prices. But throughout most of the period here in question the scope of its influence has been small. As recently as 1940, stumpage averaged only about 5 percent of all lumber costs; before 1900 it was insignificant. To be sure, if stumpage prices continue to increase at a faster rate than lumber prices, stumpage prices will become a more and more important factor in the lumber price trend. In the period studied, however, rising wage rates in the lumber industry were apparently the main factor that forced lumber prices up.

But wage rates have been rising in all industries and, as already noted in Figure 1, all-commodity prices have not been increasing as have lumber prices. The complete answer to the question of cost structure is found in the relationships between wages and productivity in the lumber industry and in the rest of the economy.

Rising Per Capita Real Income—the Cause of Rising Lumber Prices

The correspondence between per capita real income and per capita productivity is generally recognized. Suppose, for example, that during a given time period the quantity of goods and services produced by the average person increases 10 percent—that is, productivity increases 10 percent. If the proportion of output allocated to investment purposes remains constant, the average person must also consume 10 percent more goods and services. Thus an increase in per capita real income is synonymous with an increase in per capita productivity.

TABLE 1.—ANNUAL RATE OF INCREASE IN REAL INCOME IN THE UNITED STATES SINCE 1850 (*2*)

Period	Rate (Percent)
1850-1870	1.5
1870-1920	1.6
1920-1947	2.5
1947-1955	2.9

During the period under investigation per capita real income in the American economy has increased at a compound annual rate of about 2 percent (*4*). Table 1 indicates not only that real income is increasing, but that the rate of increase itself is increasing. The present generation of Americans has inherited a remarkable economy.

Changes in money wage rates have, in the long run, paralleled changes in productivity (real income) in the American economy: increases in productivity have been passed on to workers in the form of higher wage rates. When productivity in the economy increases, no sector or industry in the economy can avoid paying the resulting higher wage rates; for if an industry does not increase the wages of its labor, workers will eventually seek employment elsewhere.

When productivity in the economy increases, therefore, a given firm or industry will attempt to raise its output per worker in order to make up for its higher labor expenses. If this can be done, the firm's cost structure need not rise. If, however, the firm cannot increase its output per worker, its cost structure will shift upward.

The most exhaustive studies of productivity in the American economy have been made by S. Fabricant of the National Bureau of Economic Research (*5*, *6*). His findings, although inconclusive, indicate that there was no appreciable change in labor productivity in the lumber industry during the period covered by his analysis, 1899 to 1939. The few studies of the industry since 1939 indicate that its productivity may have decreased since World War II (*9*).

Because productivity has not increased in the lumber industry, rising money wage rates in the economy have forced the cost structure of the industry upwards. It is the fact that lumber prices in the long run are formed around this rising cost structure that explains why they have diverged from all-commodity prices.

The relationship between per capita real income and lumber prices can now be summarized: Rising per capita real income (productivity) in an era of rather constant all-commodity prices leads to an increase in money wage rates throughout the economy. Productivity in the lumber industry meanwhile remains about constant, and so the industry's cost structure is forced upward. Lumber prices must in the long run conform to costs. Rising per capita real income in the American economy may thus be thought of as the cause of the upward trend of lumber prices.

Relationships Expressed Algebraically

The relationships among prices, productivity, and income can be expressed algebraically. Assuming constant productivity in the lumber industry and constant all-commodity prices, the rate of increase in the lumber price trend will roughly equal the rate of increase in per capita real income (productivity): $1 + p = 1 + Q$, where

p = annual rate of change in trend of lumber prices

Q = annual rate of change in trend of per capita real income (productivity).

If the assumptions of constant labor productivity in the lumber industry and constant all-commodity prices are dropped, we have the general proposition that the

ratio of lumber prices to all-commodity prices varies directly with the ratio of the annual rate of change in productivity in the economy to the rate of change in productivity in the lumber industry:

$$\frac{1+p}{1+P} = \frac{1+Q}{1+q}, \text{ where}$$

P = annual rate of change in all-commodity price trend

q = annual rate of change in trend of productivity in the lumber industry.

The prices in question above are money prices. Since the real price of lumber is derived by dividing the price index of lumber by the price index of all commodities, the ratio on the left in the equation immediately above is, by definition, a measure of the rate of change in the real price trend of lumber. Thus the trend in the real price of lumber depends, fundamentally, on the relation between the trend rate of change in productivity in the economy and that in the lumber industry:

$$1+R = \frac{1+Q}{1+q}$$

where

R = annual trend rate of change in the real price of lumber.

Literature Cited

1. BRYANT, R. C. 1919. Prices of lumber. War Industries Board Price Bul. 43. Gov't Printing Office, Washington. pp. 52-54.
2. BURCK, G., and S. PARKER. 1955. Productivity: the great age of 3%. Fortune 0:102.
3. COMPTON, W. 1916. The organization of the lumber industry. Am. Lumberman, Chicago. p. 119.
4. FABRICANT, S. 1954. Economic progress and economic change. 34th Ann. Report, Nat'l. Bul. Econ. Research, New York. p. 5.
5. ———. 1942. Employment in manufacturing, 1899-1939. Pub. 41, Nat'l. Econ. Research, New York.
6. ———. 1945. Labor savings in American industry, 1899-1939. Occasional Paper 23, Nat'l. Bur. Econ. Research, New York.
7. FOSTER, E. 1946. Lumber snafu. Jour. Forestry 44:396.
8. HALL, R. C. 1946. Snafu in lumber prices. Jour. Forestry 44:685-686.
9. LOWTHER, E. J., and R. W. MURRAY. 1946. Labor requirements in southern lumber production. Monthly Labor Rev. 63:941.
10. MARSHALL, A. 1920. Principles of economics. 8th ed. Macmillan and Co. Ltd., London. p. 349.

A Test of Group Selection in Idaho Ponderosa Pine

James D. Curtis and Alvin K. Wilson
Intermountain Forest and Range Experiment Station, Forest Service, U. S. Department of Agriculture, Ogden, Utah

PONDEROSA PINE (*Pinus ponderosa* Laws.) is the most important pine in the West (*2*). Both in volume and value cut it has always ranked first in the Intermountain Region. The better quality stands of the species occur in central Idaho, where great reliance is placed on them for maintaining soil stability, providing forage and browse, and assisting in the storage of water for the arid valleys where the centers of population are located. It is the most important timber type nearest the vast dry areas of the desert.

Problems of Management

Climate.—Severity of the climate in central Idaho makes establishment of reproduction, either natural or artificial, a precarious event. Average annual precipitation, usually less than 23 inches, falls chiefly in the winter and spring. Summer (July and August) rainfall rarely exceeds 3 inches and commonly is only a trace. The granitic soils are highly dessicative, and moisture available to seedlings retreats downward faster than seedling roots can penetrate. High soil surface temperatures often kill young seedlings by injuring their tender stems. The growing season rarely exceeds 85 days. This vicious combination results in a microclimate in which healthy seedlings struggle to endure and in which those plants that occasionally do survive grow slowly and with difficulty until they are safely established.

Topography.—The terrain that supports the ponderosa pine type in central Idaho aggravates the difficulties of tree establishment and the extraction of mature timber. The species is found from 3,500 to 6,000 feet elevation on the bottoms, slopes, and ridges of the innumerable minor drainages that comprise the larger ones. On benches and in the south and west slopes ponderosa pine is found commonly in pure stands and mixed with Douglas-fir (*Pseudotsuga menziesii* [Mirb.] Franco) on north and east exposures. Logging is done by medium and large caterpillar tractors, and jammer (mobile crane with tongs) where the ground is too steep for safe operation of "cats." The latter results in a network of roads 300 to 500 feet apart, which obviously exposes considerable soil to erosion.

Seed and reproduction.—No periodicity, as such, in seed production has been recognized for ponderosa pine in central Idaho, although seed is produced frequently enough for spasmodic reproduction. Unfortunately most of it is eaten by rodents. What escapes them is available for germination, but the period of earliest growth is made precarious by the scant soil moisture. Exceptions occur only when a fortuitous combination of an unusually heavy seed crop and abnormally high precipitation in the ensuing growing season result in widespread and heavy seedling establishment. These occasions are infrequent and unpredictable; hence the natural regeneration of cutover areas is uncertain and often unsatisfactory. Even artificial regeneration, particularly on burned areas with their frequent quota of brush (*Ceanothus* spp., etc.) and/or herbaceous growth, cannot yet be considered a dependable alternative.

Enemies.—After the new stand is once established, the main problem of securing reasonable net board-foot growth per acre in pine forests is mortality of old and large individuals. The most common and serious cause of mortality is insects, of which the western pine beetle (*Dendroctonus brevicomis* Les.), the mountain pine beetle (*D. monticolae* Hopk.), and the Black Hills beetle (*D. ponderosae* Hopk.) are the most destructive. How to reduce this mortality to a minimum during the first several cutting cycles and still leave sufficient growing stock for acceptable sawtimber growth is a challenging puzzle, thus far unsolved.

Tests of Reproduction Methods and Past Practices

Since 1909, when the first experimental cutting in ponderosa pine was made (*8*), several reproduction methods (cutting systems) and marking practices have been employed for observation and test. Because reproduction methods have basic silvicultural importance, a terse review of them is presented together with an account of some harvest cuttings in which regeneration was not considered a prime objective.

Group selection.—Use of this method in the Southwest (*8*) was prompted by need for volume sufficient to meet the expenses of railroad logging. As applied, this system involved heavy cutting in groupwise fashion where advance growth was ample, and a similar procedure but leaving sufficient stems for seed where reproduction was lacking. It was not group selection in the accepted sense because regeneration was incidental. Residual volumes were from 1,800 to 4,000 bd. ft. per acre. The cutting cycle was from 60 to 100 years.

Light selection (*8*).—The light selection system, identical to the above in principle, left more trees for seed and shading to encourage reproduction; consequently a higher reserve volume remained. There was a conscious attempt here to secure reproduction rather than concern only for high net growth of the stand after cutting.

Scattered seed tree.—This method, also employed in the Southwest (*8*), left only as much merchantable timber as was considered necessary to provide seed supply. The heavy cut took virtually all merchantable stems except those needed for seed, and length of the cutting cycle equalled that of the rotation.

Favoring dominants. — This system, confined to the Southwest (*8*), was motivated by the logic that favoring dominants would at once produce copious seed of good quality and reserve the right individuals for increment. This increment would follow by the planned release around dominants in stands of both yellow pine (older age classes) and blackjacks (intermediate age classes of merchantable size.)

Salvage and sanitation-salvage cutting.—This light form of cutting (*3, 4, 9*)—actually not a reproduction method—removed only those trees obviously injured or in declining health or soon to be lost otherwise (most commonly to insects). A regular commercial cutting 10 to 30 years later is designed to bring about reproduction. The light cut involved (10 to 25 percent of the original volume), existing roads, and a terrain requiring virtually no road building are distinct advantages. This cutting has been used widely in national forest timber sales, particularly in California and Oregon. Heavier than average cuts of this type have been and are being made in Idaho.

Improvement selection. — This system, developed in the Southwest (*8*) after shortcomings of the above five systems were realized, is aimed directly at stand improvement to build up an effective growing stock; although harvesting mature timber is equally important. It strives to improve both net growth and quality, and thereby raises the value of the stand. Procedure is opposite to "Favoring dominants" and is, in effect, a selection thinning (*3*) whereby the lower, cleanboled crown classes are favored and encouraged by removing the larger, coarser dominants. Presumably reproduction is secured from seed reaching the small clearcuttings from trees in the surrounding thinned stands.

Economic selection (*10*).—In this cutting, only timber that will pay a satisfactory profit is harvested. Volumes removed vary from 35 to 75 percent of the original stand; hence, residual stands often had low quality and occasionally had undesirable composition. Insect risk was ignored in these early and now infrequent cuttings.

Tree class selection (*10*).—The residual stand is composed of individuals believed to possess post-logging growth potentialities; all other stems are cut. This involves removing from 35 to 80 percent of the volume of the original stand and obvious lengthening of the cutting cycle; no consideration is given to insect risk. This type of cutting was made in the early days in western Montana and central Idaho.

Diameter limit (*10*).—All merchantable trees are cut to a diameter limit of from 15 to 20 inches because as much as 96 percent of original volume may be removed; and the cutting cycle approximates the rotation period. As in seed tree and tree class selection cuttings, insect risk was greatly reduced in achieving a diametrically opposite objective.

Maturity selection (*7*). — This method, developed in the Pacific Northwest, relies largely on a mathematical approach. Selection of the tree to be removed depends on its financial and biological maturity. The carrying charges of the tree are determined from its conversion value, the growth-rate percentage, and the mortality-probability percentage. Trees having the highest carrying charges are felled first up to the limit of allowable cut, or about 40 percent of the initial volume.

It is instructive to observe that all these cutting systems are either of two of the four classic, fundamental high forest methods of reproduction (*3*), namely, seed tree and selection, or slight modifications of them. Any method of reproduction has two main objectives: (1) to remove the mature stand, and (2) to establish a new crop. Because ponderosa pine stands over extensive areas invariably occur in the "uneven-aged" form, either stemwise or groupwise, difficulties arise in accomplishing these two steps when it is not desired to remove the overmature (virgin) forest in one cutting and where factors beyond the forest manager's control militate against establishment of the new crop. The situation is aggravated when different geographic zones with their local biotic and climatic characteristics impose dissimilar causes of mortality through all stages of the tree's life. These facts largely account for the silvicultural systems tried in ponderosa pine during the last 48 years. While some of the systems briefly described appear promising, others do not satisfy even the basic requisites of a true reproduction method. None has thus far proved entirely adequate.

Group Selection in Central Idaho

In the simplest application of group selection, the mature trees are cut in groups. Then the forest is composed eventually of several even-aged stands (age classes) whose summed areas equal the total area of original small clearcuttings made when the groups were created. The system evidently is suited to a light-demanding species because the young trees in a group are "free to grow" (i.e., they have

no overhead competition), and each competes with its neighbors of the same age and height. Obviously this system simplifies timber-stand improvement and eventual logging of the stand, as compared to results in an uneven-aged stand cut by the stem selection in which trees of different ages and sizes are intimately mixed. The number of age classes represented depends on the rotation and the cutting cycle. In a 100-year rotation and 20-year cutting cycle, a new age class is established about every 20 years for 100 years; thus, five age classes will result. These age classes are not contiguous nor is any one age class composed of one area, but rather several or even many small areas are intermingled with those of other age classes.

The silvics of the species and the doubtful adequacy of methods tried in the past are the chief reasons for including group selection as described here in a recently installed study (*1*) on the Boise Basin Experimental Forest in central Idaho covering 841 acres. Group selection was employed on half of the 16 minor drainages (397 acres). These minor drainages or compartments, ranging from 31 to 72 acres in extent, contain a minimum of 10 acres of each of three initial average stand volumes which are designated as volume classes. Volume class I contains less than 10,000 bd. ft. (Scribner) per acre; class II contains 10,000 to 20,000 bd. ft. per acre, and class III contains 20,000 and over bd. ft. per acre. Thus a stratification of areas to be tested, delineated by productivity classes, was initially achieved.

The first step in preparation for marking was to make a stand map for each of the eight compartments which would set forth the areas occupied by each single age class, and by each combination of age classes (two-storied stands). This was accomplished by running compass lines 5 chains apart through the eight compartments and mapping these stands to a suitable scale. Stands (age classes) recognized included:

	Designated as
Openings	0
Seedlings and saplings	1
Poles	2
Immature saw trees	3
Mature saw trees	4
Overmature saw trees	5
Immature (overstory) over seedlings and saplings (understory)	3/1
Mature (overstory) over seedlings and saplings (understory)	4/1
Overmature (overstory) over seedlings and saplings (understory)	5/1
Immature (overstory) over poles (understory)	3/2
Mature (overstory) over poles (understory)	4/2
Overmature (overstory) over poles (understory)	5/2

Mapping also indicated whether immature, mature, and overmature stands were estimated to average more or less than 5,000 bd. ft. per acre. This information was a great aid in marking, especially in two-storied stands. Stands were mapped to about 0.2-acre minimum and were homogeneous in age, except where occasional age class areas, too small and irregular to be mapped independently, were included with a larger, mappable area. These delinated areas of age classes were then computed by dot-gridding and recorded by volume classes within compartments.

Regardless of the reproduction method employed on any unit of forest being managed for sustained yield, age classes in the aggregate must occupy equal areas of productivity, and reproduction must be established reasonably soon after cutting. These facts are too often overlooked, particularly when clearcutting is proposed. If silvical requirements of the species are observed and appropriate plans for regulation made, clearcutting can be a useful and efficient means to an end. In this experiment in group selection, the clearcutting was in small groups and individually did not exceed 1 acre. This was chiefly because age classes to be cut did not occur over larger areas and because of the desirability of creating areas large enough to be relatively free of root competition but small enough to be assured of plentiful seed and at least some shading from adjacent stands to ameliorate the effects of high soil surface temperatures. Areas larger than an acre could be created and still support conditions conducive to reproduction establishment.

In converting unmanaged stands to managed stands by a given reproduction method, a planned amount of cutting other than for reproduction is inevitable in most typical ponderosa pine stands. Correctly speaking, then, liberation cuttings, thinnings, and sanitation-salvage cuttings, as well as reproduction cuttings, are involved in applying group selection and in effecting initial orderly and systematic grouping of age classes (*3*).

Everything considered, 180 years was determined to be a suitable rotation age for ponderosa pine, with cuttings made every 30 years to establish regeneration. Thus, six age classes would comprise the growing stock. Each age class would therefore occupy one-sixth of the total area, which, in this instance, means each volume class area. An idea of nature's arrangement of age classes and the task of conversion to a more orderly array by the forester can be obtained by examining Table 1. Thorough inspection of age class areas in this table reveals that while group selection in ponderosa pine is a striking example of a theoretically ideal plan, it is also one that in practice taxes the forest manager's ability and resolution.

Immediately evident is the extreme variation between areas of age classes within a volume class. A disturbing fact is the low acreage of immature timber as revealed by age class "3," of common occurrence in ponderosa pine forests. How can this area be cut so that six age classes occupying equal areas will eventually make up the growing stock? Obviously, within each volume class are excesses of some age class areas and deficiencies of others. In the "0" age class of volume class II, there should be 25.1 acres $(\frac{150.8}{6})$ whereas actually there are only 2.6 acres, approximately one-tenth of what is needed to be regenerated. Furthermore, cutting the mature and overmature trees in this volume class

could create only 10.3 acres (8.2 + 2.1). Further examination will reveal additional shortcomings.

All silvicultural procedures need guides as starting points; in this experiment there were two: volume (level of reserve) and area. Levels of reserve were established arbitrarily for each volume class as follows:

Volume class *Original stand*	Level of reserve High *Bd. ft. per acre*	Low
I. 0-10,000 bd. ft./acre	6,000	4,000
II. 10,000-20,000 bd. ft./acre	11,000	8,000
III. 20,000 and over bd. ft./acre	18,500	14,500

A 100 percent inventory of trees 11.0 inches and over was available for each volume class area. Consequently, it was easy to compute an allowable cut for each prior to marking. During marking, a tally of marked trees was kept, and their volumes were totaled frequently to avoid exceeding the allowable cut.

The six age classes mentioned earlier (coded as 0, 1, 2, 3, 4, and 5) admittedly are a crude facsimile of the six age classes that comprise the forest manager's goal. These are what he has to work with, and he has no other choice as guides. After his initial attempt and after each successive cutting, the balanced structure of age classes will emerge, still six in number, but with no overmature trees (class 5) in evidence. At the end of the rotation, provided cutting criteria are observed and silvicultural principles followed, together with a measure of luck, the working circle will have this systematized makeup of age classes:

Age class	Corresponding size class
0- 30	Seedlings-saplings
30- 60	Saplings-medium poles
60- 90	Medium poles-small saw trees
90-120	Immature saw trees
120-150	Medium mature saw trees
150-180	Mature saw trees

The variation in age classes obviously will be in direct proportion to the promptness of regeneration establishment—most, if natural means are relied on, and least, if early and successful planting can be achieved.

The second criterion for marking is area; the objective here is to strive towards six age classes (listed above), each on a sixth of the total (working circle) area. To accomplish this important long-range regulatory plan, priorities must be set up. In this experiment they were as follows:

Priority	Age class Present	New	Source of additional area
First	0	0-30	Clearcutting in 5 and/or 4
Second	1	30-60	Remove overstory in areas of 5/1 and/or 4/1
Third	2	60-90	Remove overstory in areas of 5/2 and/or 4/2
Fourth	—	—	Remove highest risk sawtimber trees in areas between groupwise cuttings

Table 2 shows the figures for one of the eight compartments in Table 1. Included also are the prelogging acreages of each age class within each volume class, the areas cut over, and the net effect this cutting has on the postlogging acreages of age classes. Because six regeneration cuts are in the rotation, each age class in this minor drainage (compartment) will occupy one-sixth of the total area of 12.7 acres or 2.1 acres in volume class I. The object in this minor drainage, then,

TABLE 1.—COMPOSITE OF EIGHT MINOR DRAINAGES SHOWING TOTAL AREAS OF AGE CLASSES WITHIN EACH OF THREE VOLUME CLASSES

Volume class	Age classes[1] as mapped: One-storied 0	1	2	3	4	5	Two-storied 3/1	3/2	4/1	4/2	5/1	5/2	Total
	Acres												
I	14.4	4.7	53.7	....	0.9	0.4	0.9	31.0	5.0	14.6	1.6	7.1	134.3
II	2.6	5.1	29.1	3.5	8.2	2.1	5.0	21.9	18.3	25.1	13.3	16.6	150.8
III	1.2	2.8	9.0	2.9	11.5	12.3	5.8	2.0	22.9	6.8	27.8	7.3	112.3
	18.2	12.6	91.8	6.4	20.6	14.8	11.7	54.9	46.2	46.5	42.7	31.0	397.4

[1]0—unstocked openings (to be restocked by natural or artificial means as soon as possible).
1—seedlings and saplings (to 3" d.b.h.).
2—poles (3" to 11" d.b.h.).
3—immature sawtimber.
4—mature sawtimber.
5—overmature sawtimber.

TABLE 2.—PRELOGGING AND POSTLOGGING AGE CLASS ACREAGES IN ONE OF THE EIGHT COMPARTMENTS MARKED BY GROUP SELECTION

Volume class	Total area	1/6 of total area	Condition	One-storied 0	1	2	3	4	5	Two-storied 3/1	3/2	4/1	4/2	5/1	5/2
	Acres	*Acres*		*Acres*								*Acres*			
I	12.7	2.1	Prelogging	2.9	....	2.5	....	....	....	....	2.8	0.4	4.1	....	....
			Cutting effect[1]	....	+0.4	....	....	....	....	....	....	−0.4	....	....	....
			Postlogging	2.9	0.4	2.5	....	—	—	....	2.8	....	4.1	....	....
II	19.6	3.3	Prelogging	1.8	0.9	2.9	....	2.1	....	3.4	3.2	1.6	3.4	0.3	....
			Cutting effect	+1.3	+0.3		....	−1.3	....	....	....	....	....	−0.3	....
			Postlogging	3.1	1.2	2.9	....	0.8	....	3.4	3.2	1.6	3.4	....	....
III	14.8	2.5	Prelogging	0.4	1.5	0.3	....	2.0	....	....	....	8.4	0.9	1.3	....
			Cutting effect	+2.1	+1.0	.	....	−1.4	....	....	....	−1.2	....	−0.5	....
			Postlogging	2.5	2.5	0.3	....	0.6	....	....	....	7.2	0.9	0.8	....

[1]Plus signs indicate acreage acquired by an age class as a result of cutting; minus signs indicate acreage removed from an age class as a result of cutting.

FIG. 1.—Before and after cutting to create an area for seedlings, or "0" age class; this is planned regeneration. Reserve trees surround the area to provide seed and shade for seedlings. If reproduction does not become established within a reasonable time, the area will be planted before competition from forbs and brush becomes severe. Mature trees on this area will be cut in about 180 years.

is to cut in such a way that six age classes will be represented on equal areas. Examining the table shows that there are already 2.9 acres in the "0" age class, so that no cutting is required to establish this age class. Table 2 also shows that age classes 1, 3, 4, 5, 3/1, 5/1, and 5/2 are missing from volume class I.

Because "0" age class is present in sufficient acreage, the next priority is to cut the two-storied stand 5/1 (overmature over seedlings and saplings) to create an equal area (2.1 acres) of the next age class "1." Since no acreage of the "5/1" age class was available, a small area (0.4 acre) was secured by cutting the overstory of mature over seedlings and saplings ("4/1"), the next highest in priority. Because this was the maximum available, attention was directed to establishment of the next age class, poles or "2," but as there were originally 2.5 acres of it, no cutting was necessary to obtain the required area.

In this example, the marker established all the age classes (including reproduction) that could be established in this particular volume class. He therefore turned his attention to elimination of high-risk trees located between the groups until he reached the planned level of reserve.

Thirty years from this cutting it will be virtually impossible to create the most desirable age class of "0," and, because there will be no one-storied mature age class at that time, most of the cut then will come from the 4.1 acres of two-storied "4/2." Creation of a new "0" age class in this particular minor drainage will have to be postponed until some poles reach mature size, probably in the 2.5 acres shown for that age class.

Cutting procedure in volume class II is similar to that for volume class I. The "0" age class was established within 0.2 acre of the total needed by cutting 1.3 acres of mature timber, or "4." The "1" class was increased by 0.3 acre, but reaching the allowable cut prevented meeting the quota of this (seedling-sapling) age class as could have been done from the 1.6 acres of "4/1." This can be accomplished 15 years hence when groups are "shaped up" and additional high-risk trees between the groups are removed, but no new age classes are established.

In volume class III, 0.7 acre of

FIG. 2.—Before and after cutting to liberate a stand of seedlings and saplings, or "1" age class. By reasonable care in felling and skidding, the overstory has been removed without excessive damage to the residual stand. The new stand has been defined and is now "free to grow." Mature trees on this area will be cut in about 150 years.

"0" age class was created by cutting from areas of "4/1" but not mapped as such because of their sizes. The required acreages (2.5) of the "0" and "1" class were established. In 15 years, attention will be directed towards increasing the acreage of "2" by removing the overstory in the 0.9 acre of "4/2."

Tables 1 and 2 show clearly that in order to create age classes the marker in the field must make up his mind that, first, he cannot create what is unavailable, and second, he cannot destroy classes to create required areas (i.e., cut saplings to make "0" area). He must work with the conditions he has, which are rarely what he would like. This system obviously differs from stemwise marking, and is more difficult; and, as for similar silvicultural pursuits, the marker needs practice in it so as to gain competence and confidence. The system appears well suited to use in ponderosa pine, but requires careful training of the marker and appreciation by the administrator to be practiced successfully.

The examples of cutting illustrated in Figures 1 and 2 show that both small and large sawtimber are cut in creating groups for regeneration and release of seedlings and saplings.

The potential mortality from insects in many ponderosa pine forests logically raises the question: Is it necessary to make a sanitation-salvage cutting before group selection is applied? Table 3 presents the percentage of high insect risk (Salman-Bongberg Risk Class III and IV, and Keen Classes 4D, 4C, 3D, and 3C) and total volumes that have been removed during group selection marking.

Because the primary objective in these compartments was not reduction of potential mortality, the extreme variation in the percentages of volume removed from each of the high-risk classes, ranging from zero to 100, is readily understandable. One interesting feature, however, is the high percentages removed in the Salman-Bongberg classes IV and III, which represent the more immediate (short-term) risk of volume loss. In many areas, almost all the volume in these classes was removed; therefore substantial control of potential loss was obtained. Percentages of cut for Keen classes 4D, 4C, 3D, and 3C, while generally lower than those for the Salman-Bongberg classes, still indicate that about half the initial volume in these classes was eliminated.

Other contrasts appearing in this table are related to the two reserve levels employed to test and determine allowable cuts. This influence is emphasized by the data in column 10 showing the initial volume in high-risk trees; these data reveal that the volume of high-risk trees in each volume class differed but little between high-reserve and low-reserve compartments. Thus, the percentages of high-risk volume removed (column 11) are related directly to the intensity of cut, which was greatest for the low-reserve level and least for the high-reserve level.

Cutting to a high-reserve level, an over-all average cut of 21.5 percent, ponderosa pine only, for the four compartments (196 acres) involved, reduced chances for cutting the high-risk trees. This was especially true in volume class I, where no high-risk trees were cut, mostly because of the small cut that these low-volume stands permitted. In fact, on some areas the initial stand averaged less than the specified reserve so that no cutting was done there. In volume classes II and III, where 41.7 percent and 36.5 percent, respectively, of the original volume in high-risk trees was removed, considerably better success was achieved.

Cutting to a low-reserve level, an average cut of 39 percent of the initial pine volume in the four compartments (201 acres), increased the chances for cutting more high-risk trees. This was primarily because of their occurrence in areas that were clearcut, and secondly because they were cut by individual selection in stands between the clearcuttings. This accounts for the higher percentages of high-risk volume removed (33 percent, 66.8 percent, and 64.3 percent for volume classes I, II, and III, respectively) and represents an appreciable reduction in possible volume loss.

The compartments cut to a high reserve had 22.6 percent of their pine volume in high-risk trees in the original stand; after cutting, the reserve stand contained 18.7 percent in high-risk volume. Compartments that were cut to a low reserve originally had 23.6 percent of their volume in high-risk trees,

TABLE 3.—PERCENTAGE OF INITIAL VOLUME CUT IN EACH HIGH-RISK CLASS, TOTAL VOLUME OF HIGH-RISK TREES CUT, TOTAL VOLUME OF HIGH-RISK TREES IN INITIAL STAND, AND PERCENTAGE OF HIGH-RISK VOLUME REMOVED IN ALL EIGHT COMPARTMENTS

Volume class	Level of reserve	Amount of initial volume cut in each high-risk class[1]						Total volume cut per acre in high-risk trees	Total volume in high-risk trees in initial stand per acre	Total high-risk removed
		Salman-Bongberg		Keen						
		IV	III	4D	4C	3D	3C			
		Percent						*Board feet*	*Board feet*	*Percent*
I	High	0.0	0.0	....	0.0	....	0.0	0	636	0.0
	Low	94.9	41.9	....	0.0	....	27.8	229	694	33.0
II	High	80.3	19.5	0.0	40.7	32.2	56.7	966	2,316	41.7
	Low	82.0	75.8	....	61.7	52.5	29.9	1,673	2,503	66.8
III	High	46.8	32.2	100.0	34.5	52.9	42.2	2,331	6,394	36.5
	Low	85.6	75.3	....	52.1	37.3	44.9	3,701	5,759	64.3

[1]Percentages are based on initial volume in each risk class. Trees classed as high-risk by both the Salman-Bongberg and Keen tree classifications are included in these data only under their Salman-Bongberg class. Blanks occur where no trees of a given tree class were present.

whereas the reserve stand contained 14.5 percent in high-risk trees. Actually, these percentages are conservative as means for estimating effects of cutting in this respect because the cutting also resulted in a lower base for computing percentages remaining in the reserve stand.

The question of applying a sanitation-salvage cut as a precautionary measure to control possible insect losses, prior to instituting group selection, is frequently asked. In this experiment, and in central Idaho at least, a preliminary sanitation-salvage cut probably would cause a lengthy delay, possibly an intolerable one, in obtaining the desired groupwise stand (age class) structure, especially where high-risk volumes are as large as they were in these compartments.

For compartments that were cut to high-reserve level, initial pine volume in high-risk trees amounted to 2,771 bd. ft. per acre, and the allowable cut amounted to 2,632 bd. ft. If a thorough sanitation-salvage cut had been made, no allowable cut would have remained to be made up in group cuttings for new age classes.

In compartments designated for cutting to low-reserve level, initial pine volume in high-risk trees amounted to 2,886 bd. ft. per acre, and allowable cut to 4,800 bd. ft. Since the average initial pine volume was 12,210 bd. ft. per acre, it would appear that about 2,000 bd. ft. of the allowable cut would be available for making group cuttings and could be used effectively to accomplish this. However, since the highest priorities were given to removing overmature and mature stands to create regeneration areas, the above-average volumes in these stands would have severely restricted the extent of group cuttings.

Suggestions for Large-Scale Application of Group Selection

In this experimental installation, the main difficulties experienced in planning initial cuttings arose from the comparatively small size of the compartments and from an experimental design that required that efforts be directed toward ultimately obtaining a balancing of age class acreages within each volume class area of each compartment. In other words, each volume class area (one contained only 9 acres) had to be considered an independent unit; and plans had to be made so that each area eventually would have six age classes having equal acreage. Using such small tracts severely reduced the chances for finding a good distribution of one- and two-storied age classes, and frequently meant that some classes were absent. This, along with the necessity for maintaining a fixed reserve volume in each volume class area, imposed restrictions on planning of the initial cutting.

These limitations are pointed out because observers may suppose that difficulties of the same degree would be experienced in initial planning of an administrative application of the same system. Actually, in large-scale use, most of these restrictions would be much less severe than they were here (some would be absent) because the larger area would increase the chances for occurrence of a good distribution of age classes and would allow the manager a greater variety of alternatives in planning. Furthermore, such features as levels of reserve and volume classes probably would be eliminated, thus simplifying the work.

The two means by which group selection can be applied to management of the ponderosa pine type are ground survey and aerial photography.

Ground survey requires that the forester be familiar with the approximate location and distribution of age and size classes of growing stock on the area to be marked. This knowledge helps him gage the extent and location of areas available for reproduction and seedling, sapling, and pole stands that can be transformed from overtopped stands into "free to grow" areas that will insure systematic quotas of age classes for the future. As marking proceeds, an estimate is made of the area of each age class released. Applying this method of cutting requires no more than the will and interest to start an approximate but systematic inventory. This demands only the skill normally used in cruising. The timber marker notes down these areas in his marking book and eventually has a good estimate of his openings for reproduction (and possible planting needs) and the younger age classes that probably will require timber stand improvement work. Practice of this system should promote confidence and efficiency in future management of the working circle.

Aerial photography provides an excellent means of accomplishing even more to gain the same end. The comparative openness of most ponderosa pine stands is favorable for appraising initial stand structure by age classes. Photographs of Boise Basin Experimental Forest (taken at a representative fraction of 1/12,000 after the ground work in delineating age classes had been done), have shown that areas representing practically all the individual age classes listed in Table 2 can be recognized and delineated easily under the stereoscope.

Familiarity with ground conditions on the Experimental Forest, to the point of being able to use individual trees and small stands for making comparisons, was admittedly an advantage. However, essentially the same results could have been obtained on less familiar territory with some ground reconnaissance and the use of the simpler photo interpretation aids.

If good aerial photographs had been available early in the development of this experiment, a better appraisal of the initial stand structure could have been made—and with expenditure of less time and effort.

For application of group selection management on a larger scale, aerial photographs at the scale of 1/12,000 could be employed; but photographs at 1/15,840 probably would show sufficient detail.

In a sample working circle, field reconnaissance should precede photo interpretation to provide some ground familiarity with the

timber and to provide specific examples of timber stand conditions as aids to interpretation. This preliminary field work should include:

1. Locating and outlining on the photographs examples of each age class to be delineated. These could be used for comparisons in the office.

2. Locating single trees within each of the classes to be recognized, and measuring their crown widths and heights, both actual and photographic. These measurements would provide further guides for photo interpretation.

3. Locating and noting on the photos examples of satisfactory and unsatisfactory degrees of stocking in subsaw-size trees.

4. Locating and noting on the photos examples of different species mixtures.

Photo interpretation should be directed toward obtaining estimates of the area occupied by each of the recognized one-storied age classes or two-storied combinations of age classes. Rather than making a complete delineation of classes for the working circle, dot-sampling (*5*, *6*) directly on the photos without delineation, should be employed to obtain area estimates. Usefulness of these estimates would be increased by dot-sampling within logical subdivisions of the working circle and summing up to obtain estimates for the entire working circle. These estimates would provide basic data for appraising the present balance, or lack of balance, in age class acreages for preliminary planning. If sawtimber volume data for the circle are incomplete or lacking, they can be supplemented by a well-designed combination ground plot-photo plot sampling of sawtimber stands. Considered together, the age class area data and volume estimates provide the basis for determining allowable cut and for preparing cutting plans.

Actual delineation of age classes on the photos should be confined to areas having the prospects of being included earliest in timber sales, and should be carried out in sufficient detail to allow the marker to locate areas having highest priority for cutting and permit him to keep the concurrent area and volume cut records, which are essential to successful application of group selection.

Summary

1. A review of past cutting methods and the silvical characteristics of ponderosa pine indicated that a trial of the group selection method of reproduction in the Intermountain Region would yield practicable and valuable information.

2. Installation of an experiment on 397 acres, all in ponderosa pine type cut by group selection, was completed early in 1955 on the Boise Basin Experimental Forest. Design of this experiment provided for tests of differences attributable to three initial stand volumes per acre and two reserve stand volume levels.

3. Regulatory aspects of management by group selection necessitated close attention to the need for integration of volume and acreage requirements in cuttings, with due regard to prelogging stand structure by age classes. Details of the method used to overcome this problem are presented.

4. During the first phase of this method of reproduction the percentage of volume in high-risk trees was reduced appreciably, largely by giving high priority to creation of small clear-cut areas in groups of overmature and/or mature saw trees.

5. Suggestions are made for large-scale application of the group selection method of reproduction in the ponderosa pine type.

Literature Cited

1. CURTIS, JAMES D. 1955. A study of ponderosa pine production in central Idaho. Intermountain Forest and Range Expt. Sta. Misc. Publ. 4, 9 pp.
2. ———— and DONALD W. LYNCH. 1957. Silvics of ponderosa pine. Intermountain Forest and Range Expt. Sta. Misc. Publ. 12, 38 pp.
3. HAWLEY, RALPH C., and DAVID M. SMITH. 1954. The practice of silviculture. Ed. 6, 525 pp., illus. John Wiley and Sons, Inc., New York.
4. KEEN, F. P. 1943. Ponderosa pine tree classes redefined. Jour. Forestry 48: 186-188.
5. MOESSNER, KARL E. 1957. How important is relief in area estimates from dot sampling in aerial photos? Intermountain Forest and Range Expt. Sta. Res. Paper 42, 16 pp.
6. ————. 1957. Relation of minimum area standards to proportions obtained by dot samples of aerial photos. Intermountain Forest and Range Expt. Sta. Res. Paper 44, 13 pp.
7. MUNGER, THORNTON T. 1941. They discuss the maturity selection system. Jour. Forestry 39: 297-303.
8. PEARSON, G. A. 1950. Management of ponderosa pine in the Southwest. U. S. Dept. Agric., Agric. Monog. 6, 218 pp., illus.
9. SALMAN, K. A., and J. W. BONGBERG. 1942. Logging high risk trees to control insects in the pine stands of northeastern California. Jour. Forestry 40: 533-539.
10. WILSON, ALVIN K. 1951. Results of cutting overmature ponderosa pine in southern Idaho. Intermountain Forest and Range Expt. Sta. Res. Paper 38, 7 pp.

Control of the Turpentine Beetle in Naval Stores Stands by Spraying Attacked Trees with Benzene Hexachloride

R. H. Smith
Southeastern Forest Experiment Station, Forest Service, U. S. Department of Agriculture

In 1948, reports began to be received that the black turpentine beetle (*Dendroctonus terebrans* [Oliv.]) was aggressively killing a considerable number of pines in the South. There had been prior fragmentary reports, but nothing so alarming as these.[1] Since 1948, reports of infested areas have increased until all states from Texas eastward to Virginia and southward through Florida have been included. Several areas of beetle infestation in north Florida were watched closely from 1952 to 1955. The observations confirmed the early reports and showed that 10 percent of a stand could be attacked in a single season. This high level of activity might persist for three years or more, particularly in active naval stores operations. On a few areas of several hundred acres each, 25 percent of the stand was attacked during a single season. From the many reports and intensive observations, this beetle can now be classed as a serious pest of southern pines.

Problem

When forest owners and managers throughout the South saw the damage by the beetle becoming more severe and widespread, they requested recommendations for control. As stated by Lee,[2] they were advised to cut and salvage all attacked trees and immediately spray the stumps with a 0.5 percent BHC (benzene hexachloride) gamma isomer solution in diesel oil. Wherever applicable, particularly in association with selection cuttings, this procedure is still recommended. As is true with most forest insects, it is best to undertake control as soon as possible after the activity of the beetle has been detected.

There are, however, features of this procedure which some landowners, especially naval stores operators, find undesirable: (1) The time delay between the decision to cut and the cutting itself may be several months. During this time beetle activity continues unabated and stand mortality increases. (2) Naval stores operators are reluc-

[1] Kowal, R. J., and J. F. Coyne. The black turpentine beetle can kill trees. AT-FA Jour. 13(9): 14-15. 1951.

[2] Lee, R. E., and R. H. Smith. The black turpentine beetle, its habits and control. U. S. Forest Serv. Southern Forest Expt. Sta. Occas. Paper 138, 14 pp. 1955.

FIG. 1.—Black turpentine beetle attacks at the base of slash pine. *Left*, first month's attacks below 18 inches. *Right*, after several months the attacks are concentrated in the basal 36 inches.

tant to cut during the chipping season. (3) Because many pulpwood and sawlog operators find it unprofitable to cut as little as 10 to 15 percent of a stand, light infestations may be bypassed until losses are heavy and the beetle population high. This is unsound forest insect control. (4) Low volume of insect salvageable timber may lead to "sweetening" the cut with unattacked timber. This creates a greater disturbance in the stand and sometimes aggravates the beetle situation and disrupts management plans. (5) As many as 10 to 30 percent of the attacked trees may survive. Landowners see this and question whether they are removing trees that might have lived.

In considering these disadvantages and the possibilities of overcoming them, the results of recent insecticidal and ecological investigations were reviewed. It was found that the initial attacks on slash pine (*Pinus elliottii* Engelm.) and longleaf pine (*P. palustris* Mill.) are almost always located within the basal 18 inches of the tree and that there are usually less than eight attacks made on the tree during the first month (Fig. 1A). These represent less than 20 percent of the attacks that will be made on the tree for the duration of the attack period. The first month's attacks by themselves are usually not fatal to the tree. It is the subsequent attacks, made during the next 3 to 6 months, which kill or fatally weaken the tree. These attacks are concentrated in the basal 36 inches (Fig. 1B) though a few may eventually be made above a height of 6 feet. The beetle also makes attacks on the roots after there are some attacks on the trunk to further hasten death. It was found that in the naval stores belt the beetle is active most of the year. Recent insecticidal tests revealed that the degree of remedial control, that is the killing of insect forms beneath the bark when treatment is applied, could be increased to more than 95 percent by increasing the BHC concentration to 1 percent. The long residual preventive action of BHC by spraying the tree prior to attack had already been established.[3]

In the light of these findings it was believed that if the trees could be sprayed soon enough after the attack had started, many such trees could be saved. The spraying should reduce the beetle population and thus decrease the attacks on unattacked, unsprayed trees in the area. Such a procedure would eliminate the immediate need for cutting and would enable prompt and continuous action to be taken in compliance with the best principles of forest insect control.

Procedure

The test was started in July 1954. Two areas were selected where tree mortality had been high in 1953 and where the beetles were currently very active. One area was located in the northeast corner of Baker County, Florida. Here, 10 percent of the stand had been killed in 1953; an additional 7 percent of the stand was attacked by the time the test was started. The stand was almost pure slash pine and contained approximately 3,000 active naval stores trees. In July 1954, 221 of these trees under varying degrees of attack were sprayed. Another area of about 800 active slash pine naval stores trees served as an untreated check; this spot, which had a comparable degree of infestation, was located about 3 miles away.

Another test area containing a 20-acre block of active slash pine naval stores was located in the eastern tip of Putnam County, Florida. The area was split into two rectangular plots which ran at right angles to each other. One of the plots was a treated one, while the other served as an untreated check. They were almost identical, each having about 500 active naval stores trees and 100 trees above 8 inches d.b.h. that had not been chipped for naval stores when the test was started. Twenty-six trees in each plot had been killed in 1953 and 26 trees in each plot were currently under varying degrees of attack but still alive when the test commenced.

Thus, both the Putnam and Baker experimental areas were heavily attacked in 1953 and were also being heavily attacked in 1954. Each area had an adequate untreated check plot to serve as an indicator of the normal course of beetle activity and tree mortality. In both areas, practically all trees were 9 to 12 inches in diameter. In the Baker area a new naval stores operation had been started in 1954, though there were many 3 and 4 year-old faces in the area, while in Putnam it had been started in 1953. Tree diameter and age of naval stores operation were considered as possible variables but were determined to have no bearing on the outcome of the test. Therefore, these factors will not be considered in this report.

The procedure[4] followed in the treated test plots is briefly as follows:

1. All attacked trees were identified by the presence of one or more pitch tubes at the base of the tree. Data were taken on each tree as to the number and location of all attacks, the absence or presence of other insect activity, tree diameter, and age of naval stores operation.

2. The loose, thick bark and debris were sloughed off the tree to a height of 18 inches, or higher if there was heavy accumulation of such bark.

3. A 1 percent BHC gamma isomer solution in diesel oil or No. 2 fuel oil was applied until it ran freely down the bark (Fig. 2). At this rate, 1 gallon covered 40 to 50 square feet of bark area, which is equivalent to the bark area in the basal 18 inches of seven 12-inch trees. It was applied with a common garden sprayer, using a medium air pressure and holding

[3] Smith, R. H. Benzene hexachloride controls black turpentine beetle. Southern Lumberman 189 (2369): 155-157. Dec. 15, 1954.

[4] Smith, R. H. A control for the black turpentine beetle in south Georgia and north Florida. U. S. Forest Serv. Southeastern Forest Expt. Sta. Res. Note 76, 2 pp. 1955.

FIG. 2.—Treating slash pine attacked by black turpentine beetle. After the loose bark and debris have been sloughed off tree, the spray is applied to height of highest attack.

the nozzle within 4 inches of the bark. The spray was applied to the height of the highest attack. When the test was established, many of the trees had to be sprayed to a height of 3 or 4 feet because they had been under attack for more than one month.

After a very thorough spraying of the designated portion, a second application was immediately made around the tree, with spray directed at the basal 2 to 4 inches only. This was done because the first and greatest number of attacks are often right at the ground line, and once inside the bark the beetle makes its gallery downward on the face of the sapwood. Thus a 2-week-old attack made at the ground line may be 2 inches below when the tree is sprayed. The bark is also thickest at the ground line.

4. Each plot was examined and maintained at biweekly intervals as long as initially attacked trees were found. Any such trees found in the two treated plots were sprayed as in step 3 above. Virtually all trees in this category had to be sprayed to a height of only 18 inches since it will be recalled that the first month's attacks are almost always confined to this limited zone. Notes were taken in all plots of the number and location of additional attacks, other insect activity, and of any changes in the condition of the tree. The tree was considered dead when the foliage started to fade.

Thus, aside from the fact that two plots were sprayed, all plots were handled and recorded in the same manner. With the exception of two or three cooler months, a biweekly schedule was maintained from July 1954 to November 1955, when the data were summarized.

Results

The results in all four plots are briefly summarized in Table 1. A monthly breakdown of the data of the Putnam plots is presented in Table 2.

The sudden decrease in beetle activity in the sprayed plots was immediately apparent. Since there was not a complete cessation, a biweekly examination schedule was established and maintained. In active naval stores operations this is quite easy, since the important step of locating the attacked trees can be incorporated with the biweekly chipping schedule. By markedly reducing the beetle activity without the necessity of cutting, the first objective of the test was attained.

A second objective was to save the attacked trees. After control had been maintained for a year, it was obvious that a great majority of the attacked trees which were sprayed would live. It will be noted that mortality of the treated trees was highest for trees already attacked when the test was begun. This can be partially ex-

TABLE 1.—RESULTS OF TESTS DURING A PERIOD OF 16 MONTHS TO CONTROL INFESTATION OF BLACK TURPENTINE BEETLE ON SLASH PINE, USING A POST-ATTACK SPRAY OF BHC, 1 PERCENT GAMMA IN OIL

Time of attack	Tree mortality				Mortality reduction in sprayed plot
	Sprayed plot		Untreated plot		
	Number	*Percent*	*Number*	*Percent*	*Percent*
Putnam County Area[1]					
July-Dec. 1954	16	2.7	39	6.5	59
Jan.-Oct. 1955	3	.5	52	8.7	94
Total	19	3.2	91	15.2	79
Baker County Area[2]					
July-Dec. 1954	105	3.5	266	8.9	60
Jan.-Oct. 1955	14	.5	169	5.6	92
Total	119	4.0	435	14.5	73

[1]Data based on 600 trees per plot.
[2]Data based on 3,000 trees in sprayed plot and 800 adjusted to 3,000 in untreated plot.

plained by the fact that many of these trees had been under attack for several months. Also, root attacks by this beetle may become quite numerous as the number of trunk attacks increase; thus the roots of these trees may have been heavily attacked before the spray was applied.

It was noticed that only rarely was a tree attacked after it had been sprayed. These very few attacks were made above the sprayed zone. There were never more than one or two such attacks on a tree and their effect on the tree was considered inconsequential, especially since their appearance indicated unsuccessful attack. For more than 12 months no attacks were found in the sprayed portion of a tree. Between 12 and 16 months after the spray had been applied, a rare unsuccessful attack was recorded in the sprayed zone of a tree.

Extensive observations indicated that a heavy beetle population was present in the area. The cups attached to the trees to collect the resin served as indicators of beetle activity. An occasional survey of the beetles caught in these cups showed quite definitely that many beetles still came to the sprayed trees.

From Tables 1 and 2 it is possible to arrive at some rounded figures of the percent control which resulted from the experimental spray program. From Table 1 it can be seen that stand mortality was reduced by about 75 percent for the entire period of the test. However, when the period of time is limited to 1955, so that trees attacked when the test was started are not included, the stand mortality was reduced by more than 90 percent.

This reduction was the result of two benefits of the spraying (1) reduction in the incidence of attacked trees and (2) reduction in the mortality of attacked trees. Since both experimental areas were almost identical in these respects, the data for the Putnam area are used for illustration (Table 2). Forty-three trees in the Putnam area were attacked in the sprayed plot and 125 trees in the untreated

TABLE 2.—RESULTS OF INSECTICIDE SPRAY TESTS TO CONTROL BLACK TURPENTINE BEETLE IN PUTNAM COUNTY, FLORIDA

Month of attack	Sprayed plot: Initially attacked, sprayed	Sprayed plot: Mortality as of October 1955	Untreated plot: Initially attacked	Untreated plot: Mortality as of October 1955
1954	*Number of trees*			
July	26[1]	11	26[1]	19
August	3	2	16	10
September	6	3	3	3
October	0	0	6	3
November	0	0	6	4
December	0	0	0	0
Total	35	16	57	39
1955				
January	0	0	0	0
February	0	0	0	0
March	0	0	5	5
April	6	0	9	9
May	1	1	12	12
June	1	0	14	14
July	10	2	18	6
August	7	0	17	5
September	5	0	13	1
October	4	0	6	0
Total	34	3	94	52
Grand total	69	19	151	91

[1]Trees for July 1954 may have been under attack for several months.

plot after the test was established. This is a reduction of 66 percent in incidence of attack. For the Baker plot the reduction was about 70 percent.

The second factor which contributed to a reduction in stand mortality was the lower percent mortality of those trees which were attacked and then sprayed Throughout the period of the test there was a 54 percent reduction in the mortality of attacked-sprayed trees in the Putnam plot. When we discount trees already attacked before the test began, this reduction increased to 68 percent. (Mortality in check plot of trees attacked after the start of the test is 57.6 percent (72÷125); this times the 43 trees attacked in the sprayed plot (69—26) equals 24.7 trees anticipated mortality. The 24.7 minus the 8 which did die (19—11) equals 16.7 trees saved, or 68 percent (16.7÷24.7) reduc-

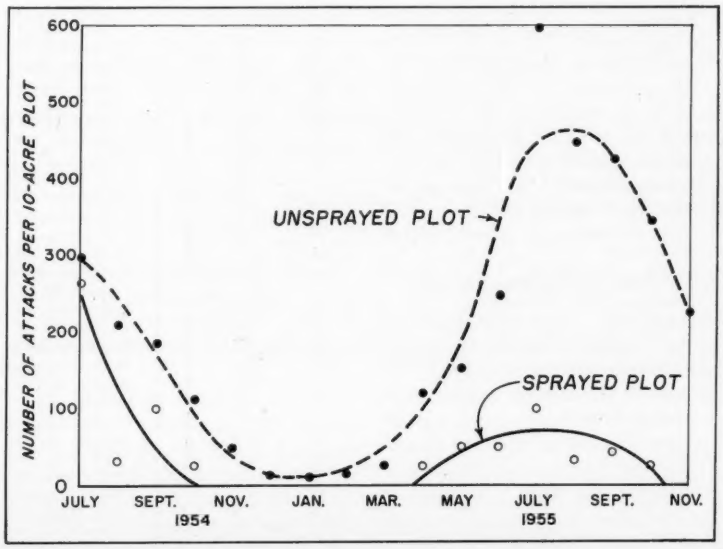


FIG. 3.—Monthly incidence of black turpentine beetle attacks in Putnam County experimental area.

tion.) For the Baker plot this reduction was 71 percent.

Thus, for convenience it is possible by rounding figures to say that after the test had been established there was a 65 to 70 percent reduction both in number of attacked trees and in mortality of those trees which were attacked and then sprayed in the treated plots. These two factors together resulted in an over-all reduction of about 90 percent in stand mortality after the test was started.

Another effect of the spray was to reduce the length of seasonal activity of the beetle. This is illustrated by Figure 3, which shows the monthly trend in the number of attacks in the sprayed and unsprayed Putnam plots. From October to April there were no attacks in the sprayed plot, but activity persisted in the unsprayed plot.

Conclusions

A properly executed and maintained program of spraying attacked trees will markedly reduce the activity of the black turpentine beetle. The spray is a 1 percent BHC gamma isomer solution in diesel oil or No. 2 fuel oil.

In the tests conducted there was a 90 percent reduction in tree mortality, which was the cumulative effect of about a 70 percent reduction in the incidence of attacked trees and 70 percent reduction in mortality of attacked trees.

Almost no beetle infestation occurred in treated areas for 16 months.

Control of the beetle by this method neither necessitates nor prohibits cutting of the attacked trees. Instead, control can be established and maintained at any time beetle activitiy is detected.

This procedure is especially adapted to the accepted principle that the time to apply control measures is before the insect has reached heavy epidemic proportions.

The method is most useful in active naval stores operations, where the important job of spotting attacked trees can be incorporated with the regular woods activities. However, there is no reason why such a procedure cannot be used in other types of forest management when salvage and stump spraying is deemed unfeasible.

SECTION BOX SCORE 1958 MEMBERSHIP

	Applications Received[1]		
	March 1958	Total 1957	Total 1958
Allegheny	5	68	29
Appalachian	2	71	10
Central Rocky Mountain	3	24	5
Central States	1	30	17
Columbia River	6	55	18
Gulf States	3	84	13
Inland Empire	7	21	10
Intermountain	0	6	28
Kentucky-Tennessee	0	8	2
New England	4	62	24
New York	1	37	15
Northern California	0	39	8
Northern Rocky Mountain	2	49	4
Ozark	2	92	14
Puget Sound	7	61	23
Southeastern	2	132	70
Southern California	0	3	0
Southwestern	0	7	0
Upper-Mississippi Valley	8	69	27
Washington	0	10	1
Wisconsin-Michigan	2	84	29
Totals	55	1,012	347

[1]Student, Junior, Affiliate, Associate (Initial) grades only.

SCHOOL BOX SCORE 1958 MEMBERSHIP

	Student Applications Received		
	March 1958	Total 1957	Total 1958
Alabama Polytechnic Institute	0	19	22
University of California	0	30	55
Colorado State University	3	19	5
Duke University	0	13	2
University of Florida	0	6	13
University of Georgia	0	86	29
University of Idaho	7	19	10
Iowa State College	0	35	9
Louisiana Polytechnic Institute	1	18	4
Louisiana State University	0	41	1
University of Maine	2	31	18
University of Massachusetts	0	10	0
Michigan Coll. of Mining & Tech.	0	29	3
Michigan State University	1	24	8
University of Michigan	0	14	10
University of Minnesota	7	28	16
University of Missouri	0	62	7
Montana State University	1	45	1
State University of New York	1	25	12
North Carolina State College	0	36	1
Oregon State College	6	29	11
Pennsylvania State University	1	32	15
Purdue University	1	18	17
Utah State University	0	5	24
University of Washington	2	27	15
West Virginia University	3	19	13
Yale University	0	7	3
Totals	36	727	324

Sodium Arsenite in Spaced Ax Cuts: an Effective Stand-Improvement Technique

Francis M. Rushmore[1]
Northeastern Forest Experiment Station,
Forest Service,
U. S. Department of Agriculture

FORESTERS have long recognized the need for an effective, economical, and easily applied treatment to eliminate unwanted trees in timber stands. Among early treatments, ax girdling without chemicals received considerable attention. Churchill, for example, began to use girdling about 30 years ago to improve stands on good softwood sites in the Adirondacks (*4*). More recently, considerable effort has been expended in search of new techniques with chemicals. As the capabilities of promising chemicals became known, new ways of applying them were tested. The search has continued for an effective, economical, and easily applied treatment that would meet the requirements of the increasing number of woodland managers who are interested in improving timber stands.

Experiments with chemicals for killing cull trees have been under way at the U. S. Forest Service's Adirondack Research Center since 1949. Sodium arsenite solution has been applied with successful results in bored holes (*7, 14, 15*) and in ax frills (*13*). However, a modification of the frill technique, in which the chemical is applied to ax cuts spaced several inches apart, has appeared to be an improvement over some other methods currently in use. Labor costs are comparatively low, and treating can be done easily without use of special tools.

The basic idea of spaced cuts is not entirely new. However, most earlier workers have either reported poor results or have recommended closer spacing between cuts than is necessary in the light of our tests.

This paper is a report of our first exploratory experiments with the spaced-cut technique, together with some information on application and costs obtained from foresters who have put the technique into practice.

Earlier Work with Chemicals

In 1931 Cope and Spaeth (*6*) found that sodium arsenite solution in single ax cuts would kill various hardwood species. They specified that "not more than one inch of unsevered bark should be left between the edges of adjacent cuts." This recommendation was based upon work with thorn-apple trees (*Crataegus* spp.). They recommended a solution strength of not less than 2 pounds of white arsenic per gallon of water. (Some commercial solutions now contain about 4 pounds of arsenic per gallon.)

However, Bull and Chapman (*2*) in 1935 reported unsatisfactory kills with various arsenical and other solutions applied in spaced cuts. They concluded that complete frills were required, but that the cost of frilling plus chemicals would be more than for conventional girdling.

Leonard reported successful results from spaced-cut treatments with undiluted 2,4-D and 2,4,5-T upon interior live oak (*Quercus wislizenii*) in 1952 (*10*), and upon blue oak (*Q. douglasii*) in 1956 (*11*). Amine forms of these chemicals were more effective than esters, and 4-inch spacing of cuts, center to center, leaving about 2 inches of unsevered bark between, was more effective than wider spacings.

In 1955 Eastment (*9*) reported good early results on hardwoods after using 40-percent sodium arsenite solution in ax cuts spaced 3 to 4 inches apart. Within four months, low-vigor trees and small trees were crown-killed, and the larger more vigorous trees—over 13 inches d.b.h.—were showing considerable injury. After one year, crown mortality on these vigorous trees averaged 70 percent.[2]

Dahms and James (*8*) reported in 1955 that preliminary trial had indicated that "pole-sized ponderosa pine trees can be killed by covering about half of the bole circumference with cuts." Four cc. of undiluted 2,4-D were injected into each cut.

Curry and Rushmore, reporting in 1955 upon experiments with arsenite solution placed in bored holes (*7*), showed that applications spaced 4 or 8 inches apart were effective. The efficacy of the frill as a means for introducing arsenite solution into a tree has been demonstrated both by some of the earlier investigators and recently by Rushmore (*13*). Thus, by inference from these findings, application in spaced cuts should be effective.

In 1956 Reines (*12*) and Wilcox et al. (*16*), though dealing with the painted-girdle method of arsenite application for purposes of bark peeling, also discuss translocation and related phenomena that pertain equally to spaced-cut treatments. They point out that the movement of arsenite is predominantly in the xylem tissues and upward and that it follows the orientation of the xylem elements with little lateral diffusion.

The Adirondack Experiments

Work with spaced single ax cuts began at the Adirondack Research Center in July 1951. Since excellent results had been obtained with bored holes spaced 4 and 8 inches apart (*7*), the ax cuts were spaced with 4 inches of unsevered bark between them. This was a departure

[1]Stationed at the Adirondack Research Center, Paul Smiths, N. Y., which is maintained by the Northeastern Forest Experiment Station in cooperation with Paul Smith's College.

[2]Personal communication from Robert R. Eastment.

TABLE 1.—CROWN KILL ON RED MAPLE AND BEECH THREE YEARS AFTER TREATMENT WITH 50 PERCENT SODIUM ARSENITE OR 3 PERCENT 2,4,5-T SOLUTIONS PLACED IN AX CUTS SPACED SEVERAL INCHES APART

Treatment made (Date)	Width between cuts	Trees used in each treatment	D.b.h.		Red maple			Beech		
			Maple	Beech	Sodium arsenite	2,4,5-T in kerosene	2,4,5-T in water	Sodium arsenite	2,4,5-T in kerosene	2,4,5-T in water
	Inches	*Number*	*Inches*	*Inches*	*Percent of crown dead in 1955*					
Feb. 26, 1952	2	4	10	9	26	10	—	90	87	—
June 12, 1952	2	4	10	10	100	58	—	83	45	—
July 28, 1952	3–4	4	9	14	100	6	15	93	29	30
Aug. 29, 1952	3–4	4	8	—	90	9	13	—	—	—

from the 1-inch spacings recommended by Cope and Spaeth (*6*). Preliminary tests soon demonstrated that 50-percent sodium arsenite solution applied in the cuts killed the crowns of forest-grown hardwoods more quickly than ammate solution of equal strength. Obviously, less time and effort would be required to make the spaced single cuts than to make holes, frills, cups, or double-hack girdles.

The tests upon which this report is based were established the next year—1952. Basically, they involved spaced-cut application of sodium arsenite and 2,4,5-T solutions to two species—red maple (*Acer rubrum*) and beech (*Fagus grandifolia*)—at four times of year.

The cuts, made by light blows with a 2½-pound ax held at a 45 degree angle, extended only slightly into the sapwood. Spacing of unsevered bark between cuts was 2 inches in the first two of the four treatments, and 3 to 4 inches in the last two. Height of cuts above ground was about 30 inches.

The sodium arsenite was used as a 50-percent water solution by weight, prepared simply by mixing equal weights of the commercial white powder and water. (Satisfactory ready-mixed 40-percent commercial solutions containing an animal repellent now are available.) The 2,4,5-T was a 3-percent solution in kerosene, by volume, made from a commercial concentrate containing 4 pounds acid equivalent per gallon. In the last two of the four treatments, a water emulsion of 2,4,5-T of the same concentration also was used. These concentrations are somewhat stronger than Chaiken's recommendation (*3*) for use in frills.

Dosage of chemicals was 2 cc. of solution per cut, applied with a paint brush or battery filler syringe. Inasmuch as a small contemporary study (*15*) has indicated that 2 cc. of arsenite solution in bored holes 8 inches apart will kill even the larger hardwoods, and the cuts in the present study were at most only 4 inches apart, the dosage here used would appear to have been amply large for the arsenite. We cannot infer, however, that 2 cc. was equally ample for the 2,4,5-T solutions.

Seasons of treatment included both winter and summer. The dates were February 26, June 12, July 28, and August 29, 1952.

The trees used in the study, though locally unmerchantable, had reasonably sound boles, normal crowns, and, being forest-grown, were generally free of low branches. The maples averaged about 9 inches d.b.h.; the beech ran somewhat larger, mostly 9 to 14 inches.

Treatment units were four trees of each species for each chemical-season combination. However, beech was omitted on the last treatment date. Total number of trees treated was 68, of which 28 were treated with arsenite, 28 with 2,4,5-T in oil, and 12 with 2,4,5-T in water (Table 1). Although four trees give a rather small basis for conclusions, the results for each chemical are considerably strengthened by their consistency across species and seasons. Moreover, this method of using arsenite in spaced cuts already has been adopted for large-scale trial on several industrial and state forest holdings; and the results from these trials greatly strengthened those from our small-scale tests.

Results and Discussion

Sodium arsenite applied in the spaced cuts resulted in acceptable crown kills except for the February treatment on red maple. Kills with 2,4,5-T as applied in these tests were generally unsatisfactory. The discussion to follow will therefore deal largely with the arsenite treatment, with only occasional mention of 2,4,5-T.

Trees treated with arsenite during the growing season typically showed crown damage within a few weeks. Foliage not initially affected continued to die during the next few months. Winter applications seemed to act somewhat more slowly. However, for all treatment dates, most of the direct crown damage became evident within one year. Sometimes one or more branches remained alive longer: those apparently had escaped the upward movement of the chemical. With the 2,4,5-T treatments, any injury that did ensue was slow to appear.

Figure 1 depicts the progress of crown kill in three years of both chemicals and both species in the July treatment. It illustrates particularly the severe early damage by arsenite, which is then followed by gradual decline of the remaining live portions of the crowns.

Crown damage after three years.—The average crown kill three years after treatment is shown for all treatments in Table 1. It will be noted that all kills in the arsenite series are good except for the February application on red maple. We suspect that, in this instance, sap flow flushed the chemical from the cuts. The air temperature was below freezing when the treatment was applied, and there was no immediate sap flow. However, later during the day temperatures rose to 35° F., and flow probably occurred at that time and during succeeding days, before the chemicals could be translocated.

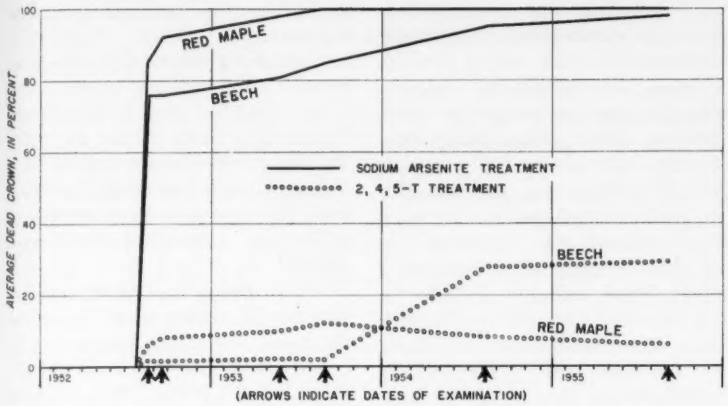


FIG. 1.—Progress of crown kill on trees treated July 28, 1952, with solutions of sodium arsenite or 2,4,5-T in ax cuts spaced 3 to 4 inches apart. Each line represents four trees.

Beech is much less inclined to produce copious sap flow. Both in earlier experiments with frill treatments (*13*) and in the present studies, sap flow similar to that which occurs from red maple has been observed on beech only near abnormalities such as rot, healed wounds, or knots.

Movement of chemicals in the tree.—Although we made no chemical or histological tests, movement of sodium arsenite in the tree can be fairly well traced by observations of discolorations in the cambial region and of mortality patterns in the tree crowns. Translocation of the arsenite seems to be confined largely to the vessels severed by the ax cuts; lateral movement sufficient to kill tissue extends only about ½ inch on either side. This pattern of movement results in dead streaks of bark and wood extending upward from the cuts into the crown. That the arsenite moves through the vessels is strikingly illustrated by spiral-grained trees, which develop a barber-pole effect of lighter and darker wood. Reines (*12*) showed by chemical tests that the arsenite moves mainly in the outer sapwood, and he also observed that the chemical follows the grain in spiral-grained trees.

The width of the dead streaks seems usually to hold fairly constant between cuts and crown. Hence, as bole diameter decreases upward, the streaks tend to converge, and if convergence is complete below the crown, all the crown dies. When complete convergence does not occur below the crown, one or more branches in the live streaks may remain alive. Since the live streak supporting such a branch typically extends downward, between two cuts, into the roots, the branch may live for several years, or indefinitely.

Vertical translocation of the arsenite was predominantly upward; downward movement, as observed also by Reines (*12*), was much slower. However, after three years, kills had extended to ground level below some of the cuts.

Spacing between cuts.—Auchter (*1*) observes that ". . . in tree injection experiments, it will be necessary to make several injections at regular intervals about the trunk if an even distribution of the materials in the top is hoped for." This accords with our observation that the dead streaks gradually converge upward as the tree bole becomes smaller, and that complete crown kill is dependent upon complete convergence below the first branches. It is obvious, therefore, that the distance between cuts should not exceed a specified maximum; also, that this allowable maximum will vary with length of clear bole and taper of bole. It may possibly vary with species and regions.

On the long-boled, forest-grown trees in our tests generally satisfactory results were obtained at 3- to 4-inch spacing between cuts. However, at 2-inch spacing, kills more often were complete—there was less tendency for live streaks and live branches to survive. Four inches probably is about the maximum spacing that can be allowed for satisfactory kills of forest-grown northeastern hardwoods.

The relationship between crown kill and the length and taper of clear bole below the crown probably explains the recommendation of Cope and Spaeth (*6*) that not more than 1 inch of unsevered bark be left between cuts; their conclusion was based upon work with thorn-apple trees, which typically have branches nearly to the ground.

Basal sprouts.—As observed both by Eastment (*9*) and ourselves, many trees treated with sodium arsenite develop basal sprouts during the first year. However, a large proportion of these sprouts die later. In our experiments, the sprouts began to die during the second and third years after the trees were treated. Their death apparently depended upon the slow downward extension of streaks and areas of dead tissue below the ax cuts. This was true for trees treated with both arsenite and 2,4,5-T in kerosene. Of 33 trees having live sprouts in 1953, all sprouts had died on ten of them by 1955, and on five more trees—a total of 45 percent—by 1956. And at least half of the sprouts had died on 15 of the remaining 18 trees. It appeared also that height growth of sprouts was somewhat depressed.

Dead sprouts almost always were located in streaks or areas of dead tissue in line with ax cuts, and live sprouts in streaks of live tissue runing between the cuts and, usually, continuing into the crown. This occurred most frequently where occasional ax cuts were more than 4 inches apart, or where the crown kill was poor.

Effect of tree size.—Although these tests were not designed to determine the effect of tree size upon the efficacy of sodium arsenite in spaced cuts, general observations

indicate that trees 8 inches or less in diameter die more quickly than larger ones of 13 inches or greater diameter, but that most of the larger trees do eventually die. However, from an appraisal of Eastment's results and our own observations, it appears that the larger more vigorous trees may be slightly more resistant, especially at the wider spacings between cuts. In the absence of more definite data, it would be good success insurance on such trees to narrow the spacing between cuts to 2 inches.

Other factors: species, season, temperature.—Since most of our experimentation has been on red maple and beech, it cannot be said positively that sodium arsenite in spaced cuts will kill all species. However, in view of the well-known high toxicity of sodium arsenite to all plant life, marked differences between species in susceptibility to spaced-cut application do not seem likely. In the previously mentioned trials by others on private and state land, American elm, black cherry, and red, white, jack, and Scotch pines, in addition to red maple and beech, have all been treated successfully. The method has not been used on oaks. Oaks succumb readily to painted girdle treatment with sodium arsenite, but Reines (*12*) has pointed out that, in members of the white oak group, tyloses restrict translocation to the outermost annual ring. These oaks, therefore, possibly might not respond as well to applications in ax cuts as do species in which tyloses are lacking.

The present state of our knowledge and experience points to the growing season as the best time for treatment. This is particularly true for strong bleeders, such as the maples. Under certain temperature conditions during the dormant season, trees of these species may flush the chemical from the cuts before much of it is absorbed. However, some successful winter treating of both pines and hardwoods other than maples has been done. More tests are needed to determine whether results with winter treatment depend primarily upon the sap-flow factor, or whether other factors are involved.

Injury to untreated trees.—Translocation of a dye or other chemical from one tree to another through root grafts has been observed by botanists and foresters on various occasions in the past. This raises the question of whether treating some trees in a stand with sodium arsenite in spaced cuts will kill or damage other trees through root translocation. With the painted-girdle technique for debarking, instances have been observed where the arsenite apparently moved through root grafts in amounts sufficient to kill neighboring trees (*16*).

Cook and Welch (*5*) have reported that this treatment may kill only a narrow strip of tissues on the bole and part of the crown of an untreated tree. Since the lateral translocation of chemicals within the bole is restricted (*1*), perhaps only partial mortality could be expected unless the chemical entered more than one of the major roots.

The only known instances of suspected damage by translocation from trees treated by the spaced-cut method are a few pines in plantations. This has been reported by two different users of the method, but the trees affected numbered no more than one to three per acre, and the evidence is only circumstantial. Even if these trees were in fact killed by translocation, the loss is relatively insignificant; however, it does point up the possibility that such damage occasionally may happen.

Application of Results and Costs

Interested Adirondack foresters have been kept informed of results of these studies as they became available. At least four owners or managers of large forest holdings in the region have been sufficiently interested in the spaced-cut technique to test it extensively on their own lands, and satisfactory kills have consistently been accomplished. Obviously the reliability of, and confidence in, the results of our small-scale tests are greatly enhanced by this successful outside experience.

Eastment's work (*9*), cited in several places above, was a 500-acre trial by the International Paper Company, started in 1954. The Draper Corporation, after preliminary tests beginning in 1952, used the method extensively in 1955 for improving hardwood stands.[3]

Finch, Pruyn and Company, interested in timber-stand improvement for more than 30 years (*4*), began using the technique in the summer of 1953. During three summers, they have applied it on 1,805 acres of their best timber lands. They plan to continue this project at the rate of at least 600 acres per year.[3]

Although 2,4,5-T and sodium arsenite solutions were compared by the above companies, results obtained generally paralleled those shown in Table 1. Finch, Pruyn and the Draper Corporation have now gone over to sodium arsenite exclusively.[3]

Preliminary tests of arsenite in spaced cuts were begun in 1953 by several of the state district foresters in the Adirondacks. In 1954 a state-wide test was initiated by the Division of Lands and Forests, New York State Conservation Department.[3]

A spacing of 3 to 4 inches between cuts was successful in all of the above large-scale tests.

Cost data have been obtained, as follows:[3]

1. International Paper Company, work on 500 acres: $4.30 per acre for labor and chemical, travel time for crew not included. Approximately 100 hardwoods, averaging 11 inches d.b.h., treated per acre.

2. Finch, Pruyn and Company, work on 1,800 acres: $6.00 per acre for labor, chemical, and including travel time for crew. About 450 trees, averaging 4 inches d.b.h., treated per acre.

3. New York Conservation Department,[4] about 2,000 pines, aver-

[3] Information obtained through personal contacts and correspondence.

[4] The personnel of the District Forester's office, Raybrook, New York.

aging 3 inches d.b.h., treated in plantation thinning. Cost on first project: $0.037 per tree. Cost on later projects: $0.01 to $0.014 per tree.

Questions for Further Research

The studies and experience here reported provide a working knowledge for using sodium arsenite in spaced cuts, but more definite answers to several questions would be helpful to the practitioner with a stand-improvement job to do. Among the most important are: (1) the effect of season of treatment and possible differences between species in reaction to treatment at different seasons; (2) the maximum allowable spacing between cuts and the effects of tree size, tree vigor, length of clear bole, and possibly species upon the allowable maximum; and (3) costs of the method in stand-improvement or thinning operations for various sizes of trees and densities of stands.

All the above points have been discussed in preceding sections, but admittedly some of the statements are speculative or are based upon weak data. It is hoped that more solid evidence will be forthcoming during the next few years.

Summary

Exploratory studies of a spaced-cut technique for poisoning trees were started at the Adirondack Research Center in 1951. Additional treatments were made in February, June, July, and August 1952. The technique involves placement of chemical solutions in ax cuts spaced several inches apart around the circumference of the tree.

Red maple and beech trees were treated with either a 50 percent solution by weight of sodium arsenite in water, or 3 percent by volume solutions of 2,4,5-T in kerosene or in water. Cuts were spaced either 2 or 3 to 4 inches apart, and about 30 inches above ground. Total crown damage three years after treatment was used to evaluate the efficacy of the treatments.

Considering both species, summer applications were more effective than those made in February. Results of the February treatment on red maple were conspicuously poor. Except for this instance, results with sodium arsenite were consistently good, with average crown kills ranging from 83 to 100 percent. Crown kills with 2,4,5-T were generally unsatisfactory.

Flushing of the chemicals from the cuts by sap flow probably accounts for the poor results from February treatment on maple. The flow from beech was negligible, and on this species sodium arsenite was as effective in February as at other seasons.

Vertical translocation of chemicals seemed to be best in summer, and it progressed upward much farther than downward.

Occasionally a streak of live tissue, running between the cuts, sustained connected branches in the crowns up to three years; some of these branches appear likely to live several years more, or indefinitely. These streaks were more often found where the spacings between cuts were wider, especially if more than 4 inches.

Study of the translocation pathways indicates that cuts may be spaced 3 or 4 inches apart on forest-grown trees with long boles, but that closer spacings probably are required for equal results on short-boled trees.

Many of the severely injured trees produced basal sprouts within one year after treatment. During the second year, sprouts began to die, as areas of dead tissue extended from the cuts to ground-level. At the end of three years, all sprouts were dead on 10 of 33 trees that had borne sprouts two years before, and many other trees possessed dead sprouts among the live ones.

Size of tree, though not critically evaluated in these tests, seemed to be a rather minor factor in terms of ultimate kills; the results were only slightly, if any, better with trees less than 8 inches in diameter than with larger ones. However, the smaller trees tended to die more rapidly.

Average costs per acre for using sodium arsenite in spaced ax cuts on undesirable hardwoods in natural mixed stands have been reported by one private company as $6.00, including travel time, and by another company as $4.30, not including travel. Pine plantations on state lands have been thinned at costs ranging from $0.01 to $0.037 per tree.

The spaced-cut technique, using 40 percent sodium arsenite solution, has already been used by private owners with good results on more than 2,300 acres of timber lands in the Adirondack Region. This method, applied during the summer season, is recommended for stand-improvement work. The 2,4,5-T solutions tested are not recommended for use in spaced cuts on northern hardwood species.

Literature Cited

1. AUCHTER, E. C. 1923. Is there normally a cross transfer of foods, water and mineral nutrients in woody plants? Univ. Md. Agric. Expt. Sta. Bul. 257: 33-60.
2. BULL, HENRY, and R. A. CHAPMAN. 1935. Killing undesirable hardwoods in southern forests. U. S. Forest Serv. South Forest Expt. Sta. Occas. Paper 50. 21 pp.
3. CHAIKEN, L. E. 1951. The use of chemicals to control inferior trees in the management of loblolly pine. U. S. Forest Serv. Southeast. Forest Expt. Sta. Sta. Paper 10. 34 pp., illus.
4. CHURCHILL, HOWARD L. 1927. Girdling of hardwoods to release young conifers. Jour. Forestry 25: 708-714.
5. COOK, D. B., and D. S. WELCH. 1957. Backflash damage to residual stands incident to chemi-peeling. Jour. Forestry 55: 265-267, illus.
6. COPE, JOSHUA A., and NELSON J. SPAETH. 1931. The killing of trees with sodium arsenite. Jour. Forestry 29: 775-783, illus.
7. CURRY, JOHN R., and FRANCIS M. RUSHMORE. 1955. Experiments in killing northern hardwoods with sodium arsenite and ammonium sulfamate. Jour. Forestry 53: 575-580.
8. DAHMS, WALTER G., and GEORGE A. JAMES. 1955. Brush control on forest lands with emphasis on promising methods for the Pacific Northwest. U. S. Forest Serv. Pacific Northwest Forest and Range Expt. Sta. Res. Paper 13. 81 pp.
9. EASTMENT, ROBERT R. 1955. Growing better tree crops in New York. Northeast. Logger (7): 7-8, illus.
10. LEONARD, O. A. 1952. Result of a cut-surface experiment on interior live oak. Western Weed Control Conf. Res. Progress Rpt. 13: 53-54.
11. ———. 1956. Effect on blue oak (*Quercus douglasii*) of 2,4-D and 2,4,5-T concentrates applied to

cuts in trunks. Jour. Range Mgmt. 9: 15-19.
12. REINES, M. 1956. Tissue differentiation and the application of sodium arsenite to girdled trees relative to bark peeling. Forest Sci. 2: 297-304.
13. RUSHMORE, FRANCIS M. 1956. The frill: a new technique in chemical debarking. Jour. Forestry 54: 329-331.
14. ————. 1956. Beech root sprouts can be damaged by sodium arsenite treatment of parent trees. U. S. Forest Serv. Northeast. Forest Expt. Sta. Forest Res. Note 57. 4 pp.
15. ————. 1956. A small quantity of sodium arsenite will destroy large cull hardwoods. U. S. Forest Serv. Northeast. Forest Expt. Sta. Sta. Paper 83. 6 pp.
16. WILCOX, HUGH, ET AL. 1956. Chemical debarking of some pulpwood species. State Univ. N. Y. Coll. Forestry Tech. Bul. 77. 43 pp., illus. Syracuse.

Observation Limits for Aerial Sketch-Mapping Southern Pine Beetle Damage in the Southern Appalachians

R. C. Aldrich, R. C. Heller, and W. F. Bailey
Research foresters,
Division of Forest Insect Research,
Forest Service, U. S. Department of Agriculture

AT THE PRESENT TIME, the most economical and practical method of locating and appraising timber losses caused by the southern pine beetle is aerial sketch-mapping. The foliage on trees that have been killed recently by beetles have distinctive red or straw-colored tops that are relatively easy to detect from the air. In cases where an aerial plotting map is to be used for directing control crews to infested trees on the ground, these infested trees must be plotted on the map within a reasonable distance of their true location and on the correct terrain feature. In September 1956 the Beltsville Forest Insect Laboratory, in cooperation with the Southeastern Forest Experiment Station,[1] made a test to determine the effect of lateral observation distance and infestation size on aerial mapping accuracy.

[1]Grateful acknowledgement is made to W. F. McCambridge, entomologist, who located the study area and served as aerial observer on all flights.

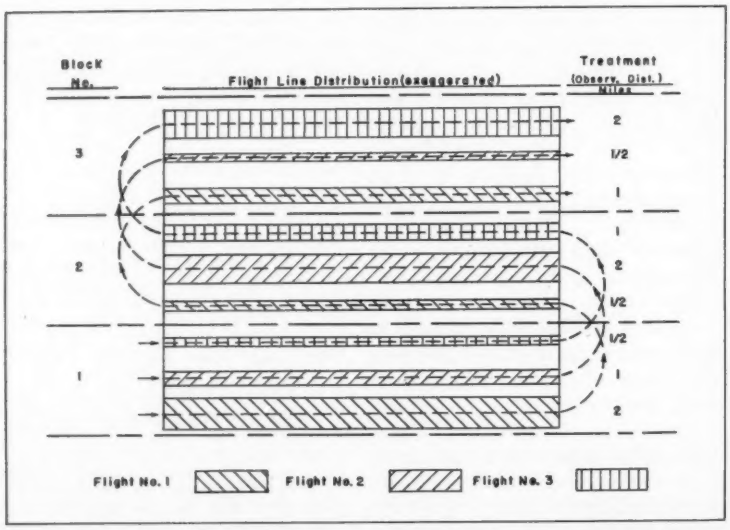


FIG. 1.—A diagrammatic sketch of the test design showing the three experimental locations and distribution of strip-width treatments for the three flights.

The test area, near Asheville, N. C., was of sufficient size to permit nine east-west lines, each 17 miles long, to be spaced two miles apart. The nine lines were divided into three blocks of three lines each (Fig. 1).

All test flights were made in a Cessna 195 airplane flown at 90 miles per hour and 1,000 feet above the terrain. Three experienced observers, one in the front of the plane and two in the rear, plotted all visible infestations as accurately as possible with respect to (1) landmarks or features of the terrain, and (2) size classes of the infestation. Size classes were designated on maps as follows:

Infestation size (*No. of trees*)	Pencil color
1	Blue dot with a figure 1 alongside
2-5	blue dot
6-20	green dot
21-50	yellow dot
51 +	red dot

The plotting was done on county highway maps scaled at 1 inch equals 1 mile. A set of these was prepared for each observer in advance. The strip widths assigned to each flight line were ruled in;

the maps cut into sections of one line per block; the three sections to be covered in a given flight assembled in consecutive order; and each flight sequence was then mounted on rollers for use on a map roller device.[2] A flight was considered as one complete round trip in which one line was covered in each block, thereby permitting each observer to cover the opposite side of a flight line on the return trip.

In the test flights, three treatments were applied to each block. A treatment consisted of having each observer plot infestations along both sides of the line for a given strip width. Within the limits imposed by the flight pattern, the three strip widths (½ mile, 1 mile, and 2 miles) were assigned within each block at random. Three treatments applied to each block minimized bias that might have resulted from uneven distribution of infestations.

Immediately after completion of the test flights, an intensive 100 percent aerial survey was made and all of the infested trees on the study area were plotted on a base map. Great care was exercised to obtain a maximum possible accuracy. Flight lines were one mile apart and, wherever necessary, the pilot circled over the infestation until two observers could plot them precisely. One observer plotted all single trees and all spots containing 2-5 trees, while the other observer plotted all infestations of the larger classes. The final base map revealed a total of 269 infestations distributed by size classes as follows: singles, 109; 2-5 class, 77; 6-20 class, 47; 21-50 class, 18; and 50+ class, 18.

The 100 percent aerial survey gave a much higher degree of accuracy than could have been obtained by conventional ground-cruising techniques. With the limited personnel available, a ground cruise of the 200,000 acre test area would have been impractical; furthermore, in the time required to make such a survey, many changes in the infestations would have invalidated the data.

Following this survey, the data on the base map was plotted on a sheet of clear acetate, and the acetate was later used as an overlay to determine the accuracy of plotting on the test strips. The infestations incorrectly plotted by each observer were separated according to the following criteria, and tallied:

1. An unplotted infestation.

2. An infestation size class recorded more than one class from the actual.

3. Plotted locations that exceeded the arbitrarily selected limits from true locations as listed below:

Nearest landmark (*Miles*)	Error if distance in miles exceeded
0-1	¼
1-2	½
2-4	1
4-6	1½

It was necessary to use distance to the nearest landmark as a standard because county highway maps lack adequate detail for accurate plotting in undeveloped areas.

Results

The plotting accuracies for three observers were compared by analysis of variance and according to the conditions under which this test was made, showed the following:

1. No differences in plotting accuracy could be detected among the observers, or when the interactions of observer by strip width and observer by spot size were compared.

2. There was a significant difference between strip widths, the ½-mile strip being the most accurate.

3. Spot size, test blocks, and the interactions between spot size by strip width showed very significant differences.

Plotting accuracy decreased as lateral distance increased (Fig. 2). When flying at 1,000 feet to detect faded tree crowns, a 1- or 2-mile-wide observation strip is too much to cover without introducing errors. In the mountains, for example, some infestations will go unobserved if surveyed at these distances because they lie in depressions or are hidden from view behind high points of land. Furthermore, while the observer's attention is focused on small groups, large spots at a distance from the airplane frequently go unobserved.

As the size of an infestation increases, so does the probability of its detection (Fig. 3). Large infestations present a better target for the eyes to detect. This plus the fact that there are generally fewer large infestations than small ones accounts for the greater accuracy. Groups of faders in the 2-5 and single size classes are difficult to detect and pinpoint accurately on a map not only because of their smaller size but also the greater numbers that usually occur in an active outbreak. For example, the frequency distribution of infestation size classes on the study area indicate that 69 percent of all spots fell in these two classes.

The fact that there was a very significant difference between blocks used in the test indicates that there was an uneven distribution of infestations. This justified the use of all three strip-width treatments on each block rather than having separate blocks for each treatment.

Recommendations

Several recommendations for improving the accuracy of sketch-mapping surveys in the mountainous areas of the South and Southeast can be derived from the results of this test and from survey experience of recent years in this section of the country.

1. Observation strip width should be restricted to ½-mile when infestations of 2-5 trees or singles are to be mapped. When these infestations are not to be plotted then it would be safe to observe a one-mile wide strip.

2. For best results, flying should be done at an altitude of 1,000 feet above the terrain and at speeds not greater than 100 miles per hour. Below this altitude, the ground is covered too rapidly to accurately

[2] Merkle, E. P., et al. 1955. Map rolling device for aerial sketch-mapping. Forest Serv. Unnumb. Note. U. S. Dept. Agric. Washington 25, D. C.

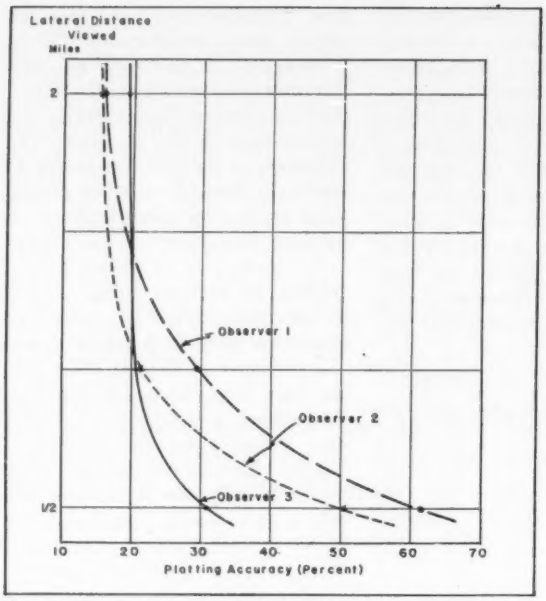


FIG. 2.—Plotting accuracy for three observers, by lateral viewing distance (including all infestation sizes).

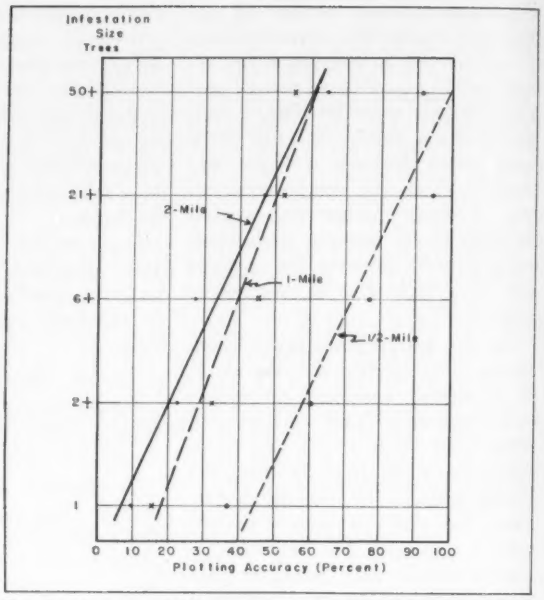


FIG. 3.—Average plotting accuracy for three observers, by infestation size and lateral viewing distance.

map infestations. Above this altitude the observer's chances of recognizing faded pine crowns are reduced.

3. Training methods are needed to increase the observer's mental acuity. Presurvey training is especially important where observers lack sufficient experience in using maps. Previous tests have shown that no reliability can be placed on inexperienced observers.

4. The best available maps or aerial photographs should always be used. Since the greatest cost of an aerial survey is incurred in putting the airplane aloft with three trained men, the small additional expense for high-standard maps or aerial photographs is more than justified by increased accuracy.

Important Notice to Subscribers

If you change your address please notify the JOURNAL OF FORESTRY preferably in advance, by letter, post card, or post office form number 22-S. Be sure to give your old, as well as the new, address with your postal zone number if any.

You should also notify your local post office on postal form number 22 of your change of address. Both postal forms are obtainable at any post office.

Copies of the JOURNAL will not be forwarded by the Post Office Department. Hence, in order to avoid missing your copy as well as to prevent extra expense to the Society in supplying duplicates, you are urged to notify the JOURNAL as soon as you know your new address, a month in advance of change if possible.

JOURNAL OF FORESTRY
425 Mills Building
17th Street at Pennsylvania Avenue, N. W.
Washington 6, D. C.

Some Effects of Thinning a Ponderosa Pine Thicket with a Prescribed Fire[1]

William G. Morris and Edwin L. Mowat

Pacific Northwest Forest and Range Experiment Station, Forest Service, U. S. Department of Agriculture

IN THE PONDEROSA PINE type, many patches of saplings and poles are so densely stocked that few or no trees are growing normally. Unless these stands of several thousand stems per acre are thinned, yield of timber in future cutting cycles will fall far short of their potential. Weaver (*5*) described this condition and attributed persistence of such thickets to exclusion of fire for several decades. He recommends prescribed burning as a useful tool for hazard reduction and for thinning overdense reproduction stands. Returns from the normally slowgrowing ponderosa pine, according to Weaver, will not now repay costs of ordinary thinning and debris disposal.

A systematic study of thinning dense patches of ponderosa pine saplings and small poles by prescribed burning was begun by Weaver in 1942. This was part of several trials of prescribed burning on the Colville Indian Reservation in north-central Washington. The general purpose was to determine whether growth of an adequate number of desirable trees could be increased by killing unneeded or less desirable competing trees. In 1950, the Pacific Northwest Forest and Range Experiment Station cooperated in remeasuring the study trees and later analyzed the data. The results reported here are limited to (1) effect of fire on tree competition, (2) crown scorching and fire scarring, and (3) growth of potential crop trees on burned and unburned plots. Complete analysis of prescribed burning, which would consider all its uses, advantages, disadvantages, and costs, is beyond the scope of this article.

Judged by results of this test, prescribed burning seems to have promise as a rough tool for thinning sapling stands of ponderosa pine. Increase in growth approximated that measured on plots in eastern Oregon and eastern Washington thinned by cutting to a similar number of reserve trees (*2*). Total area of overstocked pine thickets in which prescribed burning—or other thinning techniques—might increase timber production is not known, but it is believed to be an appreciable percentage of the ponderosa pine type.

Study Area and Stand

The 20-acre study area lies on rolling topography with gentle slopes characteristic of glaciated lands in north-central Washington. Elevation is about 2,700 feet above sea level. The sparse ground cover under the ponderosa pine stand before burning consisted principally of pinegrass, with a few weeds such as lupine and balsamroot, low semi-shrubs such as spirea, and only an occasional willow or other large shrub.

The stand typified virgin ponderosa pine on the Colville Reservation. The uneven-aged overstory was mostly comprised of irregular even-aged groups of immature, mature, and overmature trees. Overstory trees were widely spaced, partly as the result of old killing by western pine beetles. The open spaces were occupied by dense thickets of young growth, mostly about 20 years old (Fig. 1).

[1]This article is based on a cooperative study with the Bureau of Indian Affairs, U. S. Department of Interior. Acknowledgment is gratefully made to Harold Weaver, Henry Wershing, and John Drummond, successive forest managers of the Colville Indian Reservation, who with their staff members initiated the study and made or assisted in remeasurements.

FIG. 1.—Left, moderately dense patch of saplings in 1942 just before thinning by fire, and right, same view in 1950.

FIG. 2.—View in 1950 of an unburned plot in which crop trees equivalent to 125 per acre and averaging 3.5 inches d.b.h. were initially selected. Within 10 feet of each crop tree on the average there were 31 competing trees, or 4,300 per acre averaging 1.9 inches diameter at 1 foot above ground.

FIG. 3.—In a few places, heat from a concentration of several burning logs killed all of the trees, as shown by this view seven growing seasons after burning. Several new seedlings nevertheless are well established. Fire hazard in this spot has probably been increased.

Dominant trees in the young growth averaged about 14 feet high and 3 inches in diameter at breast height, with the smallest 3 percent less than 1.5 inches d.b.h. and the largest 3 percent more than 6 inches. Smaller trees ranged in size down to whips less than 3 feet high (Fig. 2). A few older poles ranging up to 10 inches d.b.h and 41 feet high were included in the study, but these were exceptional and carried little weight in results. Number of stems averaged 2,550 per acre, but varied widely from spot to spot, from none up to as many as 12,000 per acre within circular subplots of 10-foot radius. The better dominant and codominant trees had grown an average of slightly over 5 feet in height in the preceding five years. Clumps of saplings thus were overdense but, except in a few places, were not stagnating.

TABLE 1.—STAND STATISTICS FOR THE COLVILLE PRESCRIBED BURNING STUDY BEFORE AND AFTER THE FIRE

	Burned area			Unburned area	
	Before fire	After fire			
	(1942)	(1943)	(1950)	1943	1950
Crop trees:[1]					
Number per acre	——	95	83	114	111
Average d.b.h. (in.)[2]	——	3.2	4.7	3.1	4.1
Average height (ft.)	——	15.1	22.4	14.4	21.3
Competitors[3] of crop trees:					
Number per crop tree	17.3	6.5	5.0	22.5	20.5
Number per acre	2,410	895	690	3,120	2,850
Average diameter, 1 ft. above ground (in.)[4]	2.2	2.8	4.2	2.0	2.6
Basal area[5] per acre (sq. ft.)	62	39	66	69	105
Total stand, per acre:[3]					
Number	2,550	1,035	830	3,260	2,990
Basal area[5] (sq. ft.)	76	52	92	80	125

[1]Crop tree data are based on gross area of 1/5-acre sample plots: 3.4 acres in burn, 1.0 acre in unburned.
[2]Arithmetic average.
[3]Competitors and total stand data are based on a tally within a circle of 10-foot radius (0.0072 acre) around each crop tree. Since crop trees are not included in averages of competitors, 1 average crop tree is added to the circle to obtain total stand per acre.
[4]Diameter corresponding to tree of average basal area.
[5]Measured 1 foot above ground.

Burning

When the tract was burned[2] (October 6, 1942), trees were dormant and burning conditions were considered satisfactory to produce moderate heat and allow safe control of the fire. Lower vegetation had cured and, with fallen pine needles, provided abundant fuel to carry fire. The firing crew first plowed a line around the tract. They burned it during late afternoon under a heavily overcast sky and during a brisk steady southwest wind, which brings moist air to this locality. Rain was expected but did not occur.

The crew began firing along the line on sides away from the wind, and most of the time the fire advanced into the wind on a roughly semicircular front. An attempt to hurry the burning, by setting another strip of fire in advance, caused too much heat in several thick patches of saplings and poles. Thereafter, the crew set no more fire and occasionally knocked down tongues of fire burning too far ahead. Extremely hot fires occurred only around snags and along wind-

[2]Adapted from description in unpublished manuscript, "The use of controlled fire in the thinning of dense sapling and pole stands of ponderosa pine," by Harold Weaver.

falls and upturned pitchy roots (Fig. 3). This general procedure of prescribed burning has been followed on later projects on the Colville and on the Fort Apache Reservation in Arizona, except that it has been found preferable to postpone burning until after the first fall rains.

Crop-Tree Measurements

To measure effects of burning, well-distributed sapling- or pole-size crop trees were selected and tagged on burned and unburned areas[3] June 25 to July 8, 1943. All were 7 feet or more in height and averaged about 15 feet (Table 1). Kinds of measurements and records made for each crop tree were: (1) Diameter 1 foot above ground; (2) d.b.h.; (3) total height; (4) terminal growth for preceding five years; (5) percentage of crown scorch; (6) number of fire-killed and living trees within a radius of 10 feet, tallied by 0.1-inch diameter classes at 1 foot above ground. In 1945 and again in 1950, diameters and heights were remeasured to determine growth. Tallies of living trees within 10 feet were repeated to measure changes in competition.

Live trees within 10 feet were assumed to be competitors of a crop tree. The tally of these competitors was converted to total "basal area competition" and number before and after the fire.

Effect of Fire on Stand Density

An immediate effect of prescribed burning is reduction in number of trees (Fig. 1). Number of crop-tree competitors was reduced from an average of 2,410 to 895 per acre, a drop of 63 percent (Table 1 and Fig. 4). Basal area of competitors decreased 37 percent. Since these measurements are based on small plots surrounding selected crop trees, they are restricted to stocked parts of the 1/5-acre plots; average number and basal area would be slightly lower for the entire burned tract.

During the 7-year period after burning, further mortality reduced average number of competitors per acre from 895 to 690 but basal area increased above that before burning. Number of competitors per acre in the unburned stand decreased from 3,120 to 2,850 and basal area increased 52 percent. As a result, in 1950 basal area competition in the burn, although up to its pre-fire value, was only 66 percent of that in the unburned stand.

Since no tallying or tagging was done prior to burning, the study does not show proportion of area on which the fire destroyed all potential crop trees. Owing to the method of selecting unburned plots, difference between number of crop trees per acre on burned and unburned plots after the fire (Table 1) is only an approximate index of stocking reduction. Loss of stocking probably is only temporary in this area, since most of the

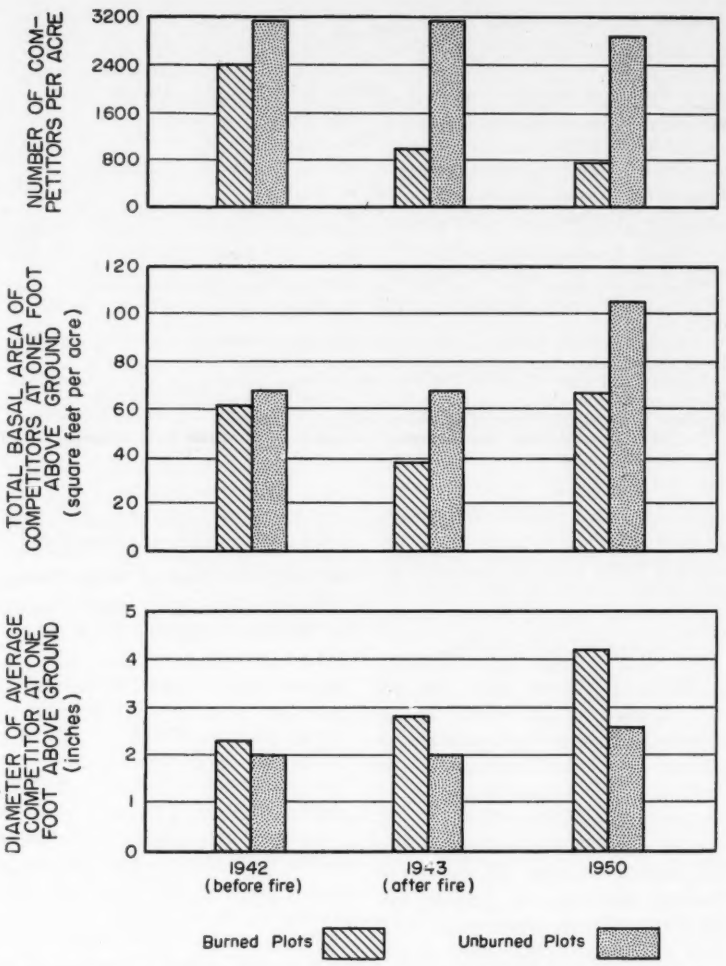


FIG. 4.—Average number, basal area, and basal diameter of competitors within 10 feet of crop trees before and after treatment with fire.

[3]On the burned tract, 17 circular 1/5-acre plots were laid out in a grid pattern with 2-chain intervals between plot centers, and well distributed crop trees were selected on these plots. Five similar plots were established in comparable thickets in surrounding unburned area at 1 to 6 chains distance from the edge of burn. Since locations of unburned plots were hand picked, they contained fewer openings, and more crop trees were available than in the burn. Method of locating these plots could have allowed a bias in growth results, but on the ground they appear to be on the same site as the burned area. The method used for analyzing growth, as described later, removes any effect of greater growth before treatment on either area and hence any probable effect of site differences.

TABLE 2.—AVERAGE GROWTH OF CROP TREES ON BURNED AND UNBURNED PLOTS 1943-1950

Measure of growth	Burned	Unburned	Excess on burned	F[1]
Fire-scarred trees on burn included:				
D.b.h.[2] (inches)	1.5	1.1	0.4	68.7
Height[3] (feet)	7.9	7.4	0.5	6.0
Fire-scarred trees on burn omitted:				
D.b.h.[4] (inches)	1.5	1.1	0.4	[4]
Height[3] (feet)	8.2	7.5	0.7	13.5
D.b.h.[5] (inches)	1.5	1.2	0.3	29.1

[1]F at the 1 percent level of probability is 6.7 and at 5 percent level is 3.9.
[2]Adjusted through covariance analysis to compensate for differences in initial d.b.h. in 1943.
[3]Adjusted through covariance analysis to compensate for differences in initial height in 1943 and differences in previous 5-year growth (1938-42).
[4]Scarred and unscarred trees had the same average initial d.b.h. and d.b.h. growth. Therefore, the covariance analysis indicated in line 1 was not repeated and "F" was assumed to be about the same as shown there.
[5]Adjusted through covariance analysis to compensate for differences in initial d.b.h. in 1943 and average basal area competition during 1943-50.

more extensive patches where fire burned too hotly have later restocked with new seedlings (Fig. 3).

Scorching and Scarring

When crop trees were first observed after the fire (July 1943), crown scorch was noted on all trees except one; but 27 percent of the trees had only 10 percent or less of the crown scorched. The remaining 73 percent were rather evenly distributed among the other 10 percent crown-scorch classes. For all crop trees, average crown scorch was 46 percent. Scorching either consumed or killed the needles, but where not too severe did not kill cambium and buds. It seemed to have no relation to presence of fire scars.

Fire scars on crop trees were first recorded in 1950. Since many scars were still covered by dead bark, area was difficult to determine and only length was recorded. Of total crop trees living in 1950, 20 percent (16.5 per acre) had noticeable fire scars. A few trees with wide and long trunk scars were deformed and showed wood decay. Probable future survival and decay of fire-scarred trees could not be accurately estimated. General experience indicates these wounds are not a great hazard for further decay. Most stump cross sections of mature trees with early basal fire scars show prompt healing, no appreciable rot, and negligible effect on lumber quality.

Subsequent Loss of Crop Trees

Many of the crop trees selected in 1943 had died by 1950, chiefly from after-effects of burning. On burned plots, losses averaged 12 trees per acre, or 12.7 percent of initial number (Table 1). During the same period, three trees or 2.6 percent of the crop trees died on unburned plots. Loss of almost 13 percent of the original crop trees on the burned area does not mean that crop-tree stocking was decreased to the same degree, because replacement trees are available in some spots. Substitute trees, however, are likely to have lower form class, poorer vigor, and less favorable spacing.

Evidence points to fire and bark beetles as contributing causes of crop-tree mortality. Fifty-one percent of the dead crop trees on the burn had been scorched on 95 to 100 percent of the crown. Only 5 percent of trees still living in 1950 had been scorched to this degree. Frass of barkbeetles had been noted in 1943 on 43 percent of crop trees that died by 1945, but was seen in 1943 on only 5 percent of those alive in 1950. Small trees were apparently more subject to loss since three-fourths of the dead trees were below average in diameter.

Growth Analysis Method

Crop trees that since 1943 had suffered top injuries not related to burning were excluded from growth analysis. On unburned plots, 96 trees (96 per acre) were retained for analysis; on burned plots, 249 trees (73 per acre). Average measurements for these crop trees are:

Item measured	Burned	Unburned
D.b.h. in 1943 (arithmetic average—inches)	3.3	3.0
Height in 1943 (feet)	15.3	14.3
Total height growth 1938-42 (feet)	5.4	5.3
Average basal-area competition per crop tree, 1943-50 (sq. in.)	51.0	86.5
Crown scorch (percent)	44.0	0

In 1950, 56 crop trees on burned plots had fire scars ranging from small basal to long trunk scars. Growth was analyzed for scarred trees, unscarred trees, and both combined.

Effect of the fire on growth was determined by comparing total growth for July 1, 1943, to April 10, 1950 on burned and unburned plots.

From previous studies, we expected that crop trees that were largest and fastest growing in 1943 would make the greatest growth during the 1943-50 period. Since the average crop tree on burned plots was initially larger in diameter and taller than the average tree on unburned plots, a direct comparison might have favored the burned plots. Therefore, to more precisely measure the effect of prescribed burning, effects of initial size (1943) and previous height growth (1938-42) were equalized through covariance analyses. Relationships of growth to initial size, previous growth rate, competition of nearby trees, and degree of crown scorching were also determined by regression analyses.

The following comparisons and tests of significance are based on the assumption that variation among crop trees within plots is a legitimate source of experimental error. Since the study provides no replication of burning treatment, use of this source of error was the only alternative. Owing to location of the study area on a gentle slope and because unburned plots

were established in a semi-circle just beyond the perimeter of burned plots, difference in site quality is unlikely.

Growth on Burned and Unburned Plots

Growth in both d.b.h. and height on burned plots exceeded that on unburned plots (Table 2). When average d.b.h. growth for each treatment was adjusted to average initial d.b.h. for both treatments combined, growth for burned plots surpassed that for unburned plots by 0.4 inch, or 36 percent. This difference is highly significant.[4] When adjusted to average initial height and previous growth rate, height growth for burned plots exceeded that for unburned plots by 0.5 foot, or 7 percent. This difference is significant; in fact it is almost highly significant.

Since elimination of surviving fire-scarred crop trees would leave adequate stocking (57 crop trees per acre) on burned plots, growth of these unscarred crop trees can be usefully compared with that on unburned plots. We assumed scarring might reduce average growth for burned plots. When fire-scarred trees were omitted, average d.b.h. growth was not measurably changed; but height growth was increased and became 0.7 foot—or 9 percent—greater than on unburned plots. This difference is highly significant.

Growth in d.b.h. was also analyzed to determine whether fire had any beneficial effect in addition to that from thinning. When adjusted to the average basal area competition as well as to initial d.b.h., average d.b.h. growth on burned plots exceeded that on unburned by 0.3 inch. This difference is highly significant. In other words, crop trees of the same initial size and with the same quantity of competition within 10 feet—measured by basal area—grew 25 percent faster on burned plots than on unburned plots. Figure 5, constructed from separate equations[5] for burned and unburned plots, illustrates this additional effect of burning on growth of crop trees.

Height growth of crop trees showed no relation to basal area competition on either burned or unburned plots. Trees with many competitors within 10 feet grew as fast as those with few. Superiority of height growth shown above for the burned plot must have been associated with other effects of the fire besides thinning.

Other Growth Relationships

As aids in predicting growth for the period 1943-50, relative importance of each independent variable, such as initial d.b.h., was judged by partial regression coefficients in standard units. In terms of d.b.h. growth, basal area competition was 25 percent more important than initial d.b.h. These two variables account for only 20 percent of variation in d.b.h. growth, and unidentified factors account for the remainder. In terms of height growth, previous 5-year growth was twice as important as initial height. These two variables account for 40 percent of variation in height growth.

Growth response to fire scars and

[4] In describing results in this paper, a difference between means or other statistics is termed "significant," according to prevailing custom, if the fiducial probability is only 5 percent that a greater difference would occur by chance; it is termed "highly significant" if that probability is only 1 percent.

[5] The regression equations are:

Unburned: $Y = 1.003 + 0.114D - 0.0031B$
$R = 0.37$ (highly significant) $SE = \pm 0.37$
Basis 96 trees. B is highly significant
D is at the 2 percent level of fiducial probability

Burned: $Y = 1.399 + 0.101D - 0.0041B$
$R = 0.42$ (highly significant) $SE = \pm 0.38$
Basis 193 trees D and B highly significant

Where: Y = inches of growth in d.b.h. (7-1-43 to 4-10-50)
D = initial d.b.h., in inches
B = basal area competition within 10 feet, in square inches
R = multiple correlation coefficient
SE = standard error of estimate

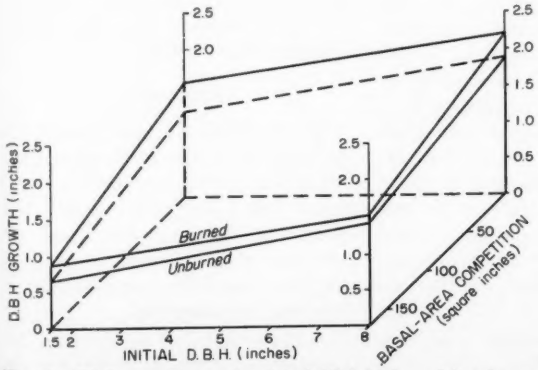


FIG. 5.—D.b.h. growth as related to initial d.b.h. and basal area competition on burned and unburned plots.

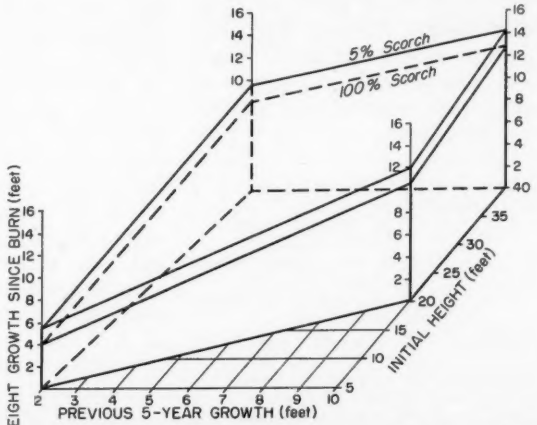


FIG. 6.—Height growth since the burn as related to previous 5-year growth, initial height, and slight vs. complete crown scorch on burned plots.

scorched crowns was studied. In d.b.h., fire-scarred trees grew as well as unscarred trees on burned plots. Similarly unscarred trees with a large percentage of the crown showing fire scorch in the first spring after the fire, grew as well in d.b.h. as trees with little scorch. But scarred or more severely scorched trees may have maintained average d.b.h. growth merely because the hotter fire that produced greater injury also killed more competitors. The basic data show less basal area competition for scarred and more completely scorched trees. For the average fire scarred tree, competition was only two-thirds of that for the average unscarred tree. Likewise, as percentage of crown scorch was increased, competition was decreased.

Contrasted with d.b.h. growth, scarred trees grew 1.1 feet less in height than unscarred trees, and height growth decreased at a highly significant rate as percentage of scorched crown increased. Since, as previously mentioned, height growth showed no relation to basal area competition, the harmful effect of scarring or scorching would not be offset by greater concurrent thinning.

Relative effects of crown scorch, initial height, and previous 5-year growth as variables of height growth on burned plots were in the ratio 1:1:2, respectively. That is, previous growth was twice as effective as either crown scorch or initial height. Figure 6 shows how previous growth and initial height were related to height growth of completely scorched and slightly scorched trees.[6]

[6]The equation from which Figure 6 was constructed is:

$$Y = 3.822 + 0.603P + 0.113H - 0.015S$$

$R = 0.66$ (highly significant) $SE = \pm 1.49$

P, H, and S are highly significant

Where Y = height growth in feet (7-1-43 to 4-10-50)
P = previous 5-year growth, in feet
H = initial height, in feet
S = percentage of crown scorch
R = multiple correlation coefficient
SE = standard error of estimate

Discussion

Cause of accelerated diameter growth of crop trees on burned plots in excess of growth related to thinning is not known. Since few shrubs or herbs grew in the dense sapling stand, reduction of competition from such plants could not have contributed materially to tree growth. Changes in soil characteristics due to burning may be responsible, but soil analyses were not included in the study.

Tarrant (*3*) found that a similar prescribed burn in the Colville locality did not harm but may have slightly improved soil permeability. Vlamis, Biswell, and Schultz (*4*) reported that prescribed fire on two ponderosa pine soils in California increased nitrogen measured one year after the burn, but did not maintain that quantity in the second year. Fuller, Shannon, and Burgess (*1*) in Arizona found that prescribed light burning in ponderosa pine stands temporarily increased fertility and had slight detrimental effect on other soil characteristics. Further studies should be made to determine whether and for how many years prescribed burning increases growth value of given soils of the ponderosa pine type.

Cost of prescribed burning and effect on fire hazard should be studied to determine its value compared to other methods of thinning. Successful prescribed burning requires thorough planning, good control lines, adequate suppression equipment, sufficient trained men for ignition or suppression, and favorable weather. These requirements add to cost of thinning by fire. Prescribed burning permanently removes part or all of such fuels as logs and slash and temporarily removes litter; but, as in other thinning methods, a residue of dead needles and stems remains. Net effect on fuel hazard 1, 3, 5, etc., years after burning should be determined for various combinations of stand condition and original hazard.

Unfortunately, fire is not selective when used for thinning. It does not thin uniformly in dense stands and may destroy all saplings in portions of the stand that were originally poorly stocked.

Prescribed fire will inevitably scar the lower trunk of some of the larger saplings that are potential crop trees. Although decay seldom enters the trunk of ponderosa pine through fire scars, the scar itself may cause a small loss in usable wood or a lumber grade defect in the core of the butt log. Under present standards such a grade defect is of small consequence because numerous knots degrade the core regardless of additional defects. However, any probable reduction in future tree values due to scarring should be considered a cost of using prescribed fire.

This experiment has demonstrated that prescribed fire, when used during favorable weather conditions and according to proper techniques, can successfully reduce competition among trees in thickets of ponderosa pine saplings in the Colville locality and increase periodic growth on 70 or more crop trees per acre. Since growth was measured for only six growing seasons after the burn, duration of this increased rate of growth is unknown.

Although the difference in growth on the burned and unburned plots in terms of inches or feet may seem trifling compared to usual 6-year growth in many forest types, the increase of 36 percent in diameter and 7 percent in height is noteworthy.

Summary

Many stands of ponderosa pine saplings grow slowly because they contain a thousand or more surplus stems per acre. Since cost often precludes thinning by hand or machine in these stands, prescribed burning has been proposed as a possible thinning tool.

A dense stand of saplings on the Colville Indian Reservation in northeastern Washington was

burned by a prescribed fire. This report describes only the effects on the stand during the first six growing seasons. A complete study of advantages, disadvantages, and costs of prescribed burning was not attempted.

Effects on potential crop trees chosen after the fire were: (1) competitors were reduced from 2,410 to 895 per acre; (2) 46 percent of the crown was scorched; (3) 20 percent of the trees developed fire scars; (4) crown scorch and fire scars adversely affected height growth, but effect on diameter growth apparently was offset by a concurrent reduction in competition; (5) competition of other trees within 10 feet affected diameter growth but not height growth; (6) crop trees on the burn grew 36 percent more in diameter and 7 percent more in height than those on the unburned plots; (7) growth in both diameter and height showed a beneficial effect of burning in addition to thinning effect.

Literature Cited

1. FULLER, W. H., STANTON SHANNON, and P. S. BURGESS. 1955. Effect of burning on certain forest soils of northern Arizona. For. Sci. 1:44-50.
2. MOWAT, EDWIN L. 1953. Thinning ponderosa pine in the Pacific Northwest—A summary of present information. U. S. Forest Serv. Pac. N.W. Forest and Range Expt. Sta. Res. Paper 5, 24 pp., illus.
3. TARRANT, ROBERT F. 1956. Changes in some physical soil properties after a prescribed burn in young ponderosa pine. Jour. Forestry 54: 439-441.
4. VLAMIS, J., H. H. BISWELL, and A. M. SCHULTZ. 1955. Effects of prescribed burning on soil fertility in second growth ponderosa pine. Jour. Forestry 53: 905-909.
5. WEAVER, HAROLD. 1955. Fire as an enemy, friend, and tool in forest management. Jour. Forestry 53: 499-504.

Report on Rhode Island's Timber Resource

Rhode Island, the smallest state in the United States and one of the most densely populated, is also extensively forested, the U. S. Forest Service reports in a publication describing the findings of its forest survey of Rhode Island.

The report, "The Timber Resources of Rhode Island," published by the Northeastern Forest Experiment Station, Upper Darby, Pa., is, according to the Forest Service, the first intensive forest survey made in Rhode Island.

The survey, which was made by the Experiment Station in cooperation with the Rhode Island Department of Agriculture and Conservation, found that two-thirds of the 677,000-acre land area of the state has some kind of forest cover. However, less than 3 percent of the forest land supports timber stands that can be classed as sawtimber.

Yet, the report points out, the forests of Rhode Island have other values that rival timber production in importance. In this densely populated state, watershed protection and recreational uses are among the most important values of the forests.

Though the state's timber values are low at present, potentially they are high. Volume of sawtimber is increasing more than three times as fast as it is being cut. The demand for wood and timber products is also increasing.

The commercial forest land carries more than 200 million cubic feet of sound wood. Less than one-fifth of this is now suitable for sawlogs. The rest of the wood is in poletimber trees and in trees and parts of trees not suitable for timber products.

Oak makes up almost two-thirds of the sawtimber volume. White pine makes up one-fifth and red maple about one-tenth. Two-thirds of the sawtimber volume was found in trees less than 15 inches d.b.h.

Copies of the report can be obtained from the Northeastern Forest Experiment Station, 102 Motors Avenue, Upper Darby, Pa.

Construction of Cubic-foot Volume Tables for Red Oak in Pennsylvania[1]

Thomas W. Beers and
Samuel F. Gingrich

A LONG-RANGE PROJECT for the construction of tree volume tables for the State of Pennsylvania was initiated in 1955. The cooperating agencies are the Pennsylvania State University School of Forestry, the Pennsylvania Department of Forests and Waters, and the Northeastern Forest Experiment Station, Forest Service, U. S. Department of Agriculture.[2] The purpose of the project is to construct volume tables for all tree species or species groups of commercial importance in Pennsylvania.

The need for standard volume tables based on sound measurements and utilizing modern methods of construction has been recognized for some time. Many volume tables are presently available, but few provide the accuracy which might be achieved through the application of modern construction methods to a reliably measured basic sample of trees. It is intended that the volume tables resulting from the present project will provide a sound premise for tree volume estimation, not only when being applied in state-wide inventories, but also when functioning as a basis for the construction of local volume tables to be used in less extensive inventories.

Northern red oak (*Quercus rubra* L.) was chosen as the pilot species to initiate the analysis of field data. The determination of the most applicable method of constructing cubic foot volume tables for red oak is discussed herein. The procedure used for obtaining cubic-foot volume, including bark, from the volume table for peeled volume is also presented.

Basic Data for Red Oak

Field measurements for 236 red oak trees comprising the basic sample were taken by personnel from the Pennsylvania Department of Forests and Waters.

The sample covered all major sections of the state where red oak was an important component of the various timber types. The field crews for the most part measured felled trees on commercial sale areas, following the felling operation as closely as possible.

An attempt was made to obtain the sample of red oak with regard to the various site classes. By measuring in cutting operations wherever they occurred, an adequate coverage of site quality was obtained. Various site quality characteristics were recorded for each felled tree and these data will be the basis for subsequent investigations of site class volume tables. It should be pointed out that on sites too poor for economical cutting operations the volume tables derived from this study may overestimate the actual volume present.

The distribution of the sample with regard to diameter at breast height and merchantable height (to a minimum 4.5-inch outside bark diameter) is shown in Table 1.

TABLE 1.—THE DISTRIBUTION OF THE SAMPLE RED OAK TREES COMPRISING THE BASIC DATA

Diameter breast high	Merchantable height classes								Diameter class total
	10	20	30	40	50	60	70	80	
Inches	*Number of trees*								
5	4	6							10
6		7	10						17
7			5	11					16
8			4	10					14
9			1	5	8	2			16
10				3	12	3			18
11					12	7			19
12				1	8	12			21
13					2	7	2		11
14					1	8	7		16
15					3	5	2		10
16					4	3	3		10
17						5	7	2	14
18						4	2		6
19						1	6		7
20						1	3	1	5
21					1	1	5		7
22						1	5	1	7
23						1	2	1	4
24									
25									
26							2		2
27							2		2
28								1	1
29						1		1	2
30						1			1
Height class total	4	13	20	30	51	63	48	7	236

[1]Authorized for publication on April 18, 1957, as paper No. 2145 in the journal series of the Pennsylvania Agric. Expt. Sta. The study was made while the authors were associated with the Pennsylvania State University. The authors are respectively, instructor of forestry, Department of Forestry and Conservation, Purdue University and Research Forester, Central States Forest Expt. Sta., Forest Service, U. S. Dept. Agric.

[2]The authors wish to acknowledge the efforts of the late Dr. H. Arthur Meyer, professor of forestry at the Pennsylvania State University, whose interest in this project was largely responsible for getting it under way. Appreciation is also given to Joseph E. Ibberson, chief of forest advisory services, Pennsylvania Department of Forests and Waters, and to C. Allen Bickford, statistician, Northeastern Forest Experiment Station for their valuable assistance in the collection and analysis of the field data.

Diameter measurements were taken with calipers at successive points along the stem of the tree. The butt log (up to 17 feet above ground) was measured at every four feet; measurements above this were taken every eight feet. The volumes of the trees were calculated by applying Newton's formula to the butt log and Huber's formula thereafter up the stem. All volume calculations for the main stem except the last section were based on eight-foot sections. Volumes of branchwood and the last section of the stem were calculated by Huber's formula using the length of section to a minimum 4.5-inch outside bark diameter. Bark thickness was measured with a bark gauge.

Height measurements were taken on felled trees with a steel tape. The merchantable height was measured to a minimum outside bark diameter of 4.5 inches, unless further limited by the tree being excessively forked or otherwise considered unmerchantable.

Construction Methods

The construction of standard volume tables has developed through three basic procedures involving graphical, alinement chart, and formula methods.

Graphical methods are the oldest and probably the simplest to employ. Often associated with the simplicity, however, is a loss of accuracy. A typical example of this type of construction is the harmonized curve method. This procedure involves the fitting of a series of curves to field data; volume being treated in terms of diameter classes and height classes. Much of the inaccuracy of this type of construction is due to the fact that there is a separate curve needed for each diameter and height class, necessitating a vast amount of basic data to provide a sound sample.

In constructing a volume table by the alinement chart method, well-known procedures are utilized for solving an equation by the construction of an alinement chart. The basic equation solved is that for the volume of a cylinder, adjusted to provide an acceptable fit to the basic data: volume, diameter, and height, as determined in the field sample. The alinement chart method is superior to the harmonized curve method because all of the field data goes into the construction of one volume curve rather than into a series of curves, resulting in a more efficient and less cumbersome procedure.

Because of the increased application of statistical procedures in forestry, formula methods of construction (often with graphical checks and shortcuts) have almost entirely replaced purely graphical and alinement chart methods. Formula methods are generally considered more desirable because of the elimination of personal bias encountered in the fitting of freehand curves, and because statistics which can be used to judge the accuracy of the resultant volume table are readily available from the least-squares procedure applied in the curve fitting.

Essentially, the formula method of construction involves the fitting of a curve (often linear) to the basic data obtained from field measurements. In the present study six different formulas were applied to the same set of red oak data. These were then compared, in order to determine the most suitable one with which to construct the desired volume table.

In the various formulas used, merchantable peeled volume to a minimum 4.5-inch outside bark diameter (designated by V), is represented as some function of diameter breast high outside bark (designated by D), and merchantable height to an outside bark diameter of 4.5 inches (designated by H).

The formulas discussed in the following paragraphs were applied to the red oak data.

One of the first formulas applied to volume table construction was the logarithmic volume equation introduced by Schumacher and Hall.[3] The basic formula considered is

$$V = D^{a_1} H^{a_2} C,$$

which can be transformed into

$$\log V = a_0 + a_1 \log D + a_2 \log H, \quad \text{(A)}$$

where a_0 is a regression constant, a_1 and a_2 are regression coefficients, and V, D, and H are as defined previously. Utilizing the basic data, a_0, a_1, and a_2 are determined by least-squares solution.

Many of the formulas proposed in recent years are discussed by Spurr.[4] Two of the more promising are termed the combined variable formula and the Australian formula. Using the same notation as above, the combined variable formula is

$$V = a_0 + a_1 D^2 H, \quad \text{(B)}[5]$$

and the Australian formula is

$$V = a_0 + a_1 D^2 + a_2 H + a_3 D^2 H. \quad \text{(C)}$$

Other formulas which were evaluated in the present study are

$$V = a_0 + a_1 D^2 + a_2 H \quad \text{(D)}$$

and $$V = a_0 + a_1 D^2 + a_2 D^2 H. \quad \text{(E)}$$

Another formula applied is a modification of the combined variable formula. Observed volumes were given a weight proportional to the reciprocal of the volume itself[6] in an attempt to correct for the increased sampling variation present in the higher diameter classes. The actual formula applied is

$$V = a_0 + a_1 D^2 H, \quad \text{(F)}$$

with the weights of observed volumes being equal to $\frac{1}{D^2 H}$.

---

[3]Schumacher, F. X., and Francisco dos Santos Hall. Logarithmic expression of timber-tree volume. Jour. Agric. Res. 47: 719-734. 1933.

[4]Spurr, Stephen H. Forest inventory. The Ronald Press Co., New York. 476 pp. 1952.

[5]This is very similar to the "form factor method" treated mathematically. The latter method presumes a constant relationship between the volume of the tree and the volume of a cylinder of the same height and with a diameter equal to the d.b.h. of the tree. Clearly then if

$$f = \frac{V_{\text{tree}}}{V_{\text{cyl.}}},$$

$$V_{\text{tree}} = f \text{ (Basal area) (Height)}$$

$$= f \frac{\pi D^2}{(4)(144)} H$$

$$= a_1 D^2 H \text{ where } a_1 = \frac{f\pi}{(4)(144)}.$$

$V = a_1 D^2 H$ can be considered approximately equivalent to $V = a_0 + a_1 D^2 H$ when, as is often the case, a_0 is numerically small.

[6]Meyer, H. Arthur. Forest Mensuration. Penns Valley Publishers, Inc., State College, Pennsylvania. 357 pp. 1953.

Analysis and Comparison of Equations

The procedure used in the analysis was as follows:

1. The given formulas were applied to the data from the field sample of 236 red oak trees; each "curve" being fitted by the least-squares method.

2. The standard error of estimate and the standard errors of the regression coefficients were calculated for each of the six equations derived from the least-squares solutions.

3. The relative merit of the formulas was determined on the basis of:

   a. The standard error of estimate, which shows the average bounds within which the true value can be expected to fall with a probability of approximately two-thirds.
   b. The reliability of the regression coefficients as indicated by the size of their standard errors.
   c. The amount of labor required in the entire procedure of least-squares solution and volume table construction.

A summary of the statistics pertaining to the final equations is presented in Table 2. Of the arithmetic equations, equation (D) can be eliminated immediately because of the large standard error of estimate. An examination of the errors of the coefficients for equations (C) and (E) indicates that the coefficients are not very reliable. With the exception of the coefficient for D^2H in each case, the errors are larger than the coefficients themselves. These coefficients obviously would not be significantly different from zero if put to a statistical test. Thus, equations (C) and (E) can be eliminated in favor of those containing only the most reliable term, D^2H.

At this point in the analysis it must be emphasized that the objective in the study is to recommend the most applicable method by which to construct the volume tables from future data. This necessarily involves the evaluation of the various methods from the standpoint of labor required in obtaining the volume equation as well as from the statistical standpoint.

Equations (B) and (F) differ very little statistically except in the size of the error of the constant a_0. Equation (F) represents the application of a weighting procedure to Formula (B) to correct for suspected differential sampling variation in volume with respect to diameter (heterogeneous variance). Since there is no increase in the precision of fit resulting from this refinement, equation (F) need not be further considered. The fact that the constant term (a_0) in equation (F) is much more reliable than that in equation (B) is of little consequence since these small additive terms would affect the final volume table only slightly.

In comparing the best of the arithmetic equations with the logarithmic equation, the standard error of estimate for the logarithmic equation in arithmetic terms must be calculated. This is done most directly by determining the residual (observed volume—predicted volume) for each tree of the basic data. The standard error of estimate calculated therefrom is comparable to those of the arithmetic equations.

The error of estimate for equation (A) proved to be slightly greater than that for equation (B), but all of the errors of the coefficients are within desirable limits. On the basis of the statistics presented it is difficult to choose between equations (A) and (B). A choice between them must be made by comparing the advantages of each, both practical and theoretical.

A basic theoretical advantage of applying the logarithmic volume formula (Equation A) is that the heterogeneity of variance, if present in the basic data, is greatly minimized. The assumption of homogeneous variance is basic to the application of an arithmetic formula. The observed data can be examined for an indication of the nature of the variance of the dependent variable and its relationship to the independent variable. Little concrete evidence was obtained to refute the assumption of homogeneous variance made in regard to applying the combined variable equation. The following observations were made:

1. When the basic data were grouped into D^2H classes (17 in all) and the variance of observed volume computed for each class, the variances were nearly constant from the lowest class to the 8th class, a range which included 73 percent of the number of trees in the sample. Very little trend was evident up to the 11th class (this range included 84 percent of the sample trees).

2. When all the variances were expressed as coefficients of variation (square root of the variance expressed as a percent of mean volume of the pertinent class) and plotted over average D^2H, no apparent trend was evident.

From the foregoing observations and from the fact that the attempt to correct for heterogeneous variance failed (Equation F) it follows

TABLE 2.—SUMMARY TABLE OF COEFFICIENTS, ERRORS, AND STANDARD ERRORS OF ESTIMATE

Formula (Equation)	Coefficients and errors for independent variables			Standard error of estimate	
Logarithmic	log k	log D	log H		
A	−0.381466 ± .012	2.060582 ± .017	0.772855 ± .019	0.02441 (in logs)	
				4.592 (absolute value)	
Arithmetic	a_0	D^2	H	D^2H	
B	0.156830 ± .406			0.002834 ± .00002	4.438
C	0.747852 ± 1.342	0.00801473 ± .014	−0.0202272 ± .027	0.00274367 ± .0002	4.454
D	−9.419071	0.199375	0.093872		6.032
E	−0.145037 ± .587	0.00981025 ± .014		0.00270064 ± .0002	4.448
F	0.362128 ± .106			0.00281705 ± .00002	4.447

TABLE 3.—MERCHANTABLE CUBIC FOOT VOLUME TABLE FOR RED OAK[1] CONSTRUCTED FROM EQUATION A[2]:
Log Volume (Tens of Cu. Ft.) = −0.380780 + 2.060582 Log D (Tens of Inches) + 0.772855 H (Tens of Feet)

Diameter breast high	Height in feet to minimum 4.5 inch top outside bark diameter: 10	20	30	40	50	60	70	80	90	100	110	Basis: Number of trees
Inches	Merchantable peeled volume in cubic feet (to 4.5-inches outside bark)											
5	1.00	1.70	2.33	2.91	3.46							10
6	1.45	2.48	3.39	4.24	5.04	5.80						17
7	2.00	3.41	4.66	5.83	6.92	7.97	8.98					16
8	2.63	4.49	6.14	7.67	9.11	10.5	11.8					14
9		5.72	7.83	9.78	11.6	13.4	15.1	16.7				16
10		7.11	9.73	12.1	14.4	16.6	18.7	20.8	22.7			18
11		8.65	11.8	14.8	17.5	20.2	22.8	25.3	27.7			19
12		10.4	14.2	17.7	21.0	24.2	27.3	30.2	33.1			21
13			16.7	20.9	24.8	28.5	32.1	35.6	39.0	42.4		11
14			19.5	24.3	28.9	33.2	37.5	41.5	45.5	49.3		16
15			22.4	28.0	33.3	38.3	43.2	47.9	52.4	56.9		10
16			25.6	32.0	38.0	43.8	49.3	54.7	59.9	65.0		10
17			29.0	36.3	43.1	49.6	55.9	61.9	67.9	73.6		14
18			32.7	40.8	48.5	55.8	62.9	69.7	76.3	82.8		6
19				45.6	54.2	62.4	70.3	77.9	85.3	92.6	99.6	7
20				50.7	60.2	69.3	78.1	86.6	94.8	103	111	5
21				56.0	66.6	76.7	86.4	95.7	105	114	122	7
22				61.7	73.3	84.4	95.0	105	115	125	135	7
23				67.6	80.3	92.5	104	115	126	137	148	4
24				73.8	87.7	101	114	126	138	150	161	—
25					95.4	110	124	137	150	163	175	—
26					103	119	134	149	163	177	190	2
27					112	129	145	161	176	191	206	2
28					120	139	156	173	190	206	222	1
29					129	149	168	186	204	221	238	2
30					139	160	180	200	219	237	255	1
Basis: trees	4	13	20	30	51	63	48	7	—	—	—	236

[1]Measured in Pennsylvania by personnel from the Pennsylvania Department of Forests and Waters. Prepared by the formula method by T. W. Beers, in 1956. Volume computed by Newton's and Huber's formulas. Stump of 1 foot not included in volume cited. Standard error of estimate is 4.59 cubic feet. Heavy lines indicate limits of basic data.
[2]Adjusted.

TABLE 4.—MERCHANTABLE CUBIC FOOT VOLUME TABLE FOR RED OAK[1] CONSTRUCTED FROM THE COMBINED VARIABLE FORMULA, EQUATION B:
$V = .156830 + .002834\ D^2H$

Diameter breast high	Height in feet to minimum 4.5 inch top outside bark diameter: 10	20	30	40	50	60	70	80	90	100	110	Basis: number of trees
Inches	Merchantable peeled volume in cubic feet (to 4.5-inches outside bark)											
5	0.87	1.57	2.28	2.99	3.70							10
6	1.18	2.20	3.22	4.24	5.26	6.28						17
7	1.55	2.93	4.32	5.71	7.10	8.49	9.88					16
8	1.97	3.78	5.60	7.41	9.23	11.0	12.9					14
9		4.75	7.04	9.34	11.6	13.9	16.2	18.5				16
10		5.82	8.66	11.5	14.3	17.2	20.0	22.8	25.7			18
11		7.02	10.4	13.9	17.3	20.7	24.2	27.6	31.0			19
12		8.32	12.4	16.5	20.6	24.6	28.7	32.8	36.9			21
13			14.5	19.3	24.1	28.9	33.7	38.5	43.3	48.1		11
14			16.8	22.4	27.9	33.5	39.0	44.6	50.1	55.7		16
15			19.3	25.7	32.0	38.4	44.8	51.2	57.5	63.9		10
16			21.9	29.2	36.4	43.7	50.9	58.2	65.5	72.7		10
17			24.7	32.9	41.1	49.3	57.5	65.7	73.9	82.1		14
18			27.7	36.9	46.1	55.2	64.4	73.6	82.8	92.0		6
19				41.1	51.3	61.5	71.8	82.0	92.2	102	113	7
20				45.5	56.8	68.2	79.5	90.8	102	114	125	5
21				50.1	62.6	75.1	87.6	100	113	125	138	7
22				55.0	68.7	82.5	96.2	110	124	137	151	7
23				60.1	75.1	90.1	105	120	135	150	165	4
24				65.5	81.8	98.1	114	131	147	163	180	—
25					88.7	106	124	142	160	177	195	—
26					95.9	115	134	153	173	192	211	2
27					103	124	145	165	186	207	227	2
28					111	133	156	178	200	222	245	1
29					119	143	167	191	215	238	262	2
30					128	153	179	204	230	255	281	1
Basis: trees	4	13	20	30	51	63	48	7	—	—	—	236

[1]Measured in Pennsylvania by personnel from the Pennsylvania Department of Forests and Waters. Prepared by the formula method by T. W. Beers in 1956. Volume computed by Newton's and Huber's formulas. Stump of 1 foot not included in volume cited. Standard error of estimate is 4.44 cubic feet. Heavy lines indicate limits of basic data.

that heterogeneity of variance, if present, represents no real deterrent to the application of the combined variable formula.

The logarithmic approach introduces a complication known as a logarithmic transposal discrepancy, but this can be corrected for by an adjustment of the least-squares equation. The primary disadvantage to the logarithmic approach lies in the necessity of transformation of the observed data to logarithms prior to the least-squares solution.

It is probable that the volume tables constructed from either equation could be used with equal confidence. In fact, within the limits of the basic data the final tables compare very well. (Compare Tables 3 and 4).

Table 3 was constructed from the logarithmic equation (corrected for transposal discrepancy):

Log of Volume (tens of cu. ft.) = −0.380780 + 2.060582 log of d.b.h. (tens of inches) + 0.772855 log of merchantable height (tens of feet)

Table 4 was constructed from the combined variable equation:

Tree Volume = 0.156830 + 0.002834 (d.b.h.)^2(merchantable height)

It can be concluded that the combined variable formula provides the simplest, sufficiently precise method for the construction of the desired cubic foot volume for red oak in Pennsylvania.

A unique feature of the combined variable formula is that the volume table can readily be expressed graphically by a single straight line. In some cases the linear relationship does not hold over the entire range of D^2H, particularly in the lower values. When the deviation from linearity is considerable, a graphical correction may be in order. No correction was applied in the present study; the small amount of curvilinearity present appeared negligible.

The Cubic-Foot Volume Table for Unpeeled Wood

In the volume calculations from the field measurements, merchantable volume had been computed inclusive and exclusive of bark. The applicability of a given formula should not change whether including or excluding bark in the tree volume. Rather than construct a table for unpeeled wood by applying the same procedure as for peeled wood, it was found to be simpler to utilize the known values of bark volume expressed as a percent of unpeeled volume. The procedure followed is outlined below.

1. Average bark volume (designated by BV) calculated for each one inch diameter class was expressed as a percentage of unpeeled volume (designated by V). This can be expressed symbolically as

$$BV(\%) = \frac{BV}{V} \times 100$$

or

$$BV(\%) = \frac{V\text{-}v}{V} \times 100$$

where v is peeled volume.

2. Each percentage so obtained was plotted over the average d.b.h. for that diameter class, and a curve was fitted by the method of least squares to the weighted points.

3. Balanced bark volume percentages were then read from the graph for diameter class midpoints.

4. These balanced values were applied to obtain unpeeled volume as indicated from the following relationships:

Since $BV\% = \frac{BV}{V} \times 100,$

$= \frac{V\text{-}v}{V} \times 100,$

Solving for V,

$$\frac{V(BV\%)}{100} = V\text{-}v$$

$$V - \frac{V(BV\%)}{100} = v$$

$$V(1 - \frac{BV\%}{100}) = v$$

$$V = \frac{v}{1 - \frac{BV\%}{100}} = \text{unpeeled volume}$$

5. Thus the red oak cubic foot volume table in terms of unpeeled wood, Table 5, was obtained by multiplying the values in Table 4 by the reciprocal of $1 - \frac{BV\%}{100}$. The values of $BV\%$ were applied to each diameter class, regardless of the height class. It was deemed unnecessary to determine the relationship between bark volume and height for the conversion procedure.

TABLE 5.—MERCHANTABLE CUBIC FOOT VOLUME TABLE FOR RED OAK IN TERMS OF UNPEELED VOLUME CONSTRUCTED BY APPLYING BALANCED BARK VOLUME PERCENTAGES TO TABLE 4

Diameter breast high	Height in feet to minimum 4.5 inch top outside bark diameter: 10	20	30	40	50	60	70	80	90	100	110	Basis: number of trees
Inches	Merchantable unpeeled volume in cubic feet (to 4.5-inches outside bark)											
5	1.15	2.08	3.02	3.96	4.89							10
6	1.53	2.85	4.17	5.49	6.81	8.13						17
7	1.97	3.71	5.48	7.24	9.00	10.8	12.5					16
8	2.45	4.69	6.95	9.20	11.5	13.7	16.0					14
9		5.78	8.56	11.4	14.1	16.9	19.7	22.5				18
10		7.01	10.4	13.8	17.2	20.7	24.1	27.5	30.9			18
11		8.43	12.5	16.7	20.8	24.9	29.1	33.2	37.2			19
12		9.97	14.9	19.8	24.7	29.5	34.4	39.3	44.2			21
13			17.3	23.1	28.8	34.6	40.3	46.1	51.8	57.5		11
14			20.1	26.7	33.3	40.0	46.5	53.2	59.8	66.5		16
15			23.0	30.6	38.1	45.7	53.4	61.0	68.5	76.1		10
16			26.0	34.7	43.3	51.9	60.5	69.2	77.8	86.4		10
17			29.3	39.0	48.7	58.5	68.2	77.9	87.6	97.3		14
18			32.8	43.7	54.5	65.3	76.2	87.1	98.0	109		6
19				48.5	60.6	72.6	84.8	96.8	109	120	133	7
20				53.6	66.9	80.3	93.6	107	120	134	147	5
21				58.9	73.6	88.3	103	118	133	147	162	7
22				64.5	80.6	96.7	113	129	145	161	177	7
23				70.3	87.9	105	123	140	158	176	193	4
24				76.5	95.5	115	133	153	172	190	210	—
25					103	124	144	165	186	206	227	—
26					112	134	156	178	201	223	245	2
27					120	144	168	191	216	240	263	2
28					129	154	181	206	232	257	284	1
29					137	165	193	221	248	275	303	2
30					148	176	206	235	265	294	324	1
Basis: trees	4	13	20	30	51	63	48	7	....	....	....	236

Summary

A study of methods of volume table construction was begun in 1956 in order to recommend the most applicable procedure to be used in volume table construction in Pennsylvania. Red oak was chosen as a pilot species to start the basic analysis.

Using the data obtained from 236 felled red oak trees, the actual cubic foot volume was computed for each tree. Newton's and Huber's formulas were utilized for this purpose. Various experimental formulas were then applied to the basic data in an attempt to obtain the best expression capable of predicting cubic foot volume in terms of d.b.h. and merchantable height.

Six formulas were evaluated, among them being the logarithmic volume equation, the Australian formula, and the combined variable formula. The relative merit of each formula was judged on the basis of its standard error of estimate (degree of fit to the basic data), the reliability of its regression coefficients, and the amount of labor involved in applying it to volume table construction.

The combined variable formula proved to be the most applicable one to recommend for volume table construction involving similar field data. This formula is represented symbolically as

$$V = a_0 + a_1 D^2H;$$

the cubic foot volume (V) being expressed in terms of one "combined variable," diameter squared times height (D^2H).

The cubic foot volume table for red oak constructed on the basis of the equation $V = .156830 + .002834\ D^2H$ is presented; the volume being exclusive of bark volume.

A cubic foot table showing volume including bark (unpeeled) is also presented, as well as an outline of the method used in obtaining it from the basic table. Bark volume percentages were used in the conversion.

Effect of Soil Amendments on Growth of Shortleaf Pine

ELMER R. ROTH
and THOMAS C. EVANS
Plant pathologist and mathematical statistician, respectively, Southeastern Forest Experiment Station, Forest Service, U. S. Department of Agriculture

INTEREST IN forest soil fertilization has been steadily increasing during the past few years. However, few large-scale experiments have been established. With the present emphasis in this country on growing more timber to meet our future needs, it is important that the results of previous work be evaluated as a guide in planning future forest fertilization studies.

In studying the nutritional aspects of the littleleaf disease of pine, researchers applied amendments to the soil surface of plots containing diseased and healthy shortleaf pine trees. The fertilizer was applied evenly over the entire surface of the plot and adjacent isolation strip. The plots were located on Madison, Louisa, and Hayesville soils on the General Pickens District of the South Carolina National Forests near Walhalla, South Carolina.

Madison soil includes textures from coarse sandy loam to clay loam; gravelly types due to the presence of small angular or platy quartz mica schist and quartz gravel; and a few stony types. The principal types of Louisa are sandy loam and sandy clay loam, with gravelly sandy loam and clay loam as lesser types. Principal types of Hayesville soil are loam and fine sandy loam, with clay loam as a minor type.

Fertilizers providing large amounts of nitrogen prevented the onset of littleleaf in healthy trees and caused the symptoms to disappear in many diseased trees.[1] Some of these plots have been established for a period of 11 years (Series F and G), some for 9 years (Series L), and some for 8 years (Series M). The purpose of this paper is to appraise the effects of the different amendments on the diameter growth of the apparently healthy dominant and codominant trees on the plots—a byproduct of the littleleaf investigation. All plots were 1/20 acre in size, with an additional 17-foot strip around them that was also treated.

The number of trees per plot varied at the start, and later losses due to littleleaf and bark beetles account for additional variation. Treatments for each series of plots are shown in Table 1. Each treatment was replicated in each series of plots, and the average diameter growth per tree for the duplicate plots is shown in Table 1. Series F, G, and L were in stands 25 to 35 years old, and Series M was in stands 15 years old and thus below littleleaf age. All plots included in this study were refertilized every three years. As indicated in Table 1, Series F and G plots receiving NPK were fertilized with enough additional nitrate of soda to bring the available nitrogen up to 220 pounds per acre. Plots receiving nitrogenous fertilizers in Series L and M received more than 300 pounds of available nitrogen per acre.

TABLE 1.—DIAMETER GROWTH OF SHORTLEAF PINE FOLLOWING FERTILIZATION[1]

Treatment	Pounds per acre	Series F: Mean annual diameter growth Before treatment	Series F: Mean annual diameter growth After treatment	Series F: Difference in growth rate	Series G: Mean annual diameter growth Before treatment	Series G: Mean annual diameter growth After treatment	Series G: Difference in growth rate
		Inches			*Inches*		
NPK (3-9-6) & sodium borate & nitrate of soda	2,000 15 1,000	.10	.22	.12[2]	.12	.23	.11[2]
NPK (3-9-6) & trace elements & nitrate of soda	2,000 (3) 1,000	.12	.22	.10[2]	.11	.19	.08
NPK (3-9-6) & nitrate of soda	2,000 1,000	.19	.27	.08[2]	.10	.16	.06[2]
Stable manure	40,000	.14	.16	.02	.15	.19	.04
Leafmold	80,000	.11	.11	.00	.14	.18	.04
Sodium borate	15	.11	.11	.00	.09	.10	.01
Check	———	.13	.12	—.01	.15	.14	—.01
		Series L			Series M		
Sulfate of ammonia	1,600	.12	.15	.03	.25	.21	—.04
Nitrate of soda & gypsum	2,000 1,000	.11	.13	.02	.34	.26	—.08
Nitrate of soda	2,000	.09	.10	.01	.34	.23	—.11
Milorganite	5,000	.12	.12	.00	.28	.19	—.09
Leafmold	40,000	.10	.10	.00	.32	.18	—.14
Gypsum	1,000	.12	.11	—.01	.26	.16	—.10
Muriate of potash	160	.10	.07	—.03	.29	.15	—.14
Check	———	.10	.09	—.01	.32	.16	—.16

[1]The comparisons are based upon average annual diameter growth for the 5 years before treatment, as compared with the average annual growth for the full period following treatment.

[2]These increases were found to be significant at the 1 percent level when tested by covariance analysis.

[3]Trace elements and the rates per acre are as follows: Sodium borate 15 pounds; copper sulfate 25 pounds; magnesium sulfate 50 pounds; manganese sulfate 50 pounds; ammonium molybdate 7 pounds.

[1]Roth, Elmer R., E. Richard Toole, and George H. Hepting. Nutritional aspects of the littleleaf disease of pine. Jour. Forestry 46:578-587. 1948.

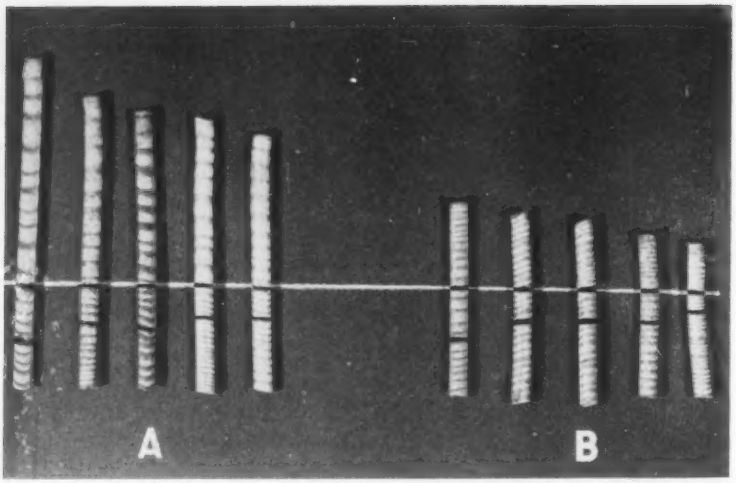


FIG. 1.—Above horizontal line equals 11 years growth since treatment; below horizontal line, the rings between marks on cores represent five years growth before treatment. *A*, Increment cores from shortleaf pine trees fertilized with NPK plus boron plus supplemental nitrate of soda. *B*, Increment cores from unfertilized adjacent shortleaf pine trees.

Results

In 1955, increment cores were taken from 10 dominant or codominant healthy trees on each plot, or, if 10 trees were not available, from all dominant and codominant healthy trees on the plot. In order to compare the diameter growth of treated trees with untreated trees, five dominant or codominant trees adjacent to each plot but beyond the zone of fertilizer influence were bored. The diameter growth of the plot trees was compared with the adjacent trees when tests were made for significance by covariance analysis. In Table 1, showing difference in diameter growth for the various treatments, the check represents the bored trees adjacent to all plots within any one series. Assuming that the check trees made normal growth, comparison of their growth difference with that of the treated plots would represent the expected response due to treatment.

All of the treatments, with the exception of muriate of potash in Series L, resulted in growth as good as or better than the checks. It is evident that complete fertilizer plus supplemental nitrate of soda, which in general about doubled growth, increased the diameter growth more than any of the inorganic nitrogenous fertilizers alone (Fig. 1). The results in Table 1 show that NPK plus supplemental nitrate of soda gives the best growth response on the particular soils tested. There is some indication in Series L and M that sulfate of ammonia when used alone gives better results than nitrate of soda.

None of the treatments in Series L and M showed any significant difference in growth over the checks, although the available nitrogen applied per acre was greater than in Series F and G.

Discussion

The trees fertilized in this study were, for the most part, small (12 inches d.b.h. and under). Even though some treatments resulted in increased growth, the trees did not put on enough additional board or cubic foot volume to result in important differences in volume.

Generally, if one plot included in a treatment responded well, the other plot receiving the same treatment also responded. However, in a few cases one of duplicate plots responded better than the other. Similarly not all individual trees on a plot responded equally well.

The record shows that plots responding favorably received larger amounts of fertilizer added more frequently than the average owner could apply with profit. The present retail value of fertilizers applied to the plots that showed beneficial growth response is from $18.00 to $24.00 per acre per year. When we consider that the average increment per acre per year for pure shortleaf pine on an average site is 1.0 to 1.5 cords, or about 400 board feet,[2] we can readily see that the additional growth added as a result of the fertilizers used in this study would not pay for the fertilizer applied. It is possible that fertilizers could be added in smaller amounts and less frequently with little change in growth response. The results reported here are in no way considered final. These results show that fertilizing shortleaf pine on the soils and under the conditions described in these experiments is of doubtful value when measured in terms of growth response. In compact soils such as the ones fertilized in this study, some of the fertilizer is washed away and some is tied up before it reaches the roots. The greatest response from forest soil fertilization can be expected on the deep sands of the Coastal Plains and on other depleted soils.

[2] U. S. Forest Service. Volume, yield, and stand tables for second-growth southern pines. U. S. Dept. Agric. Misc. Pub. 50, 202 pp., illus. 1929.

Notes

Deep Girdles Give Quickest Crown Kill of Oaks

When it is important to kill hardwood crowns quickly, a girdle that goes all the way through the sapwood will probably be more effective than shallower girdles. Near Birmingham, Alabama, the crowns of some species of upland oaks died within a few days when the sapwood was completely severed during the spring. Of course, deep girdles take substantially longer to make than conventional ones.

The trees in the test were southern red (*Quercus falcata* Michx.), scarlet (*Q. coccinea* Muenchh.), and post (*Q. stellata* Wangenh.) oaks ranging from 7 to 15 inches in d.b.h. They were girdled during May. One treatment removed only a 4-inch band of bark, another removed the bark and one chip of wood, and the third completely severed the sapwood. Figure 1 illustrates the three treatments.

The more nearly the sapwood was severed, the more quickly the trees died. On the average, trees with sapwood cut through died within 11 days, those with one chip of wood removed lived 90 days, and those with only the bark removed lingered for 137 days. Regardless of the depth of girdle, post oaks lived substantially longer than the other two species. For all three treatments combined, the time required for the crown to die averaged 52 days for southern red oak, 50 for scarlet oak, and 136 for post oak. Statistically, the mean differences in time from girdling until crown death were highly significant between treatments and between species.

Why post oak should take longer to die was not apparent, but differences in sapwood thickness did not seem responsible. Post oak sapwood was about 0.6 inch thicker than that of scarlet oak but almost identical with that of southern red oak.

It took almost as long to remove only the bark as it did to remove the bark and one chip of wood, but complete severance of the sapwood trebled the time required. The average times in seconds per tree were 51, 55, and 170 for the three treatments. Differences between species were not significant.

Sprouting was not serious for any treatment. Most of the girdled trees put out one or more shoots, but these began to die almost as soon as they had formed. Only 15 percent of the treated trees had live sprouts by the end of the first growing season, and only 8 percent by the end of the second growing season. Most of the remaining sprouts are sickly and unlikely to need further attention.

HERBERT A. YOCOM
Southern Forest Experiment Station, Forest Service, U. S. Department of Agriculture

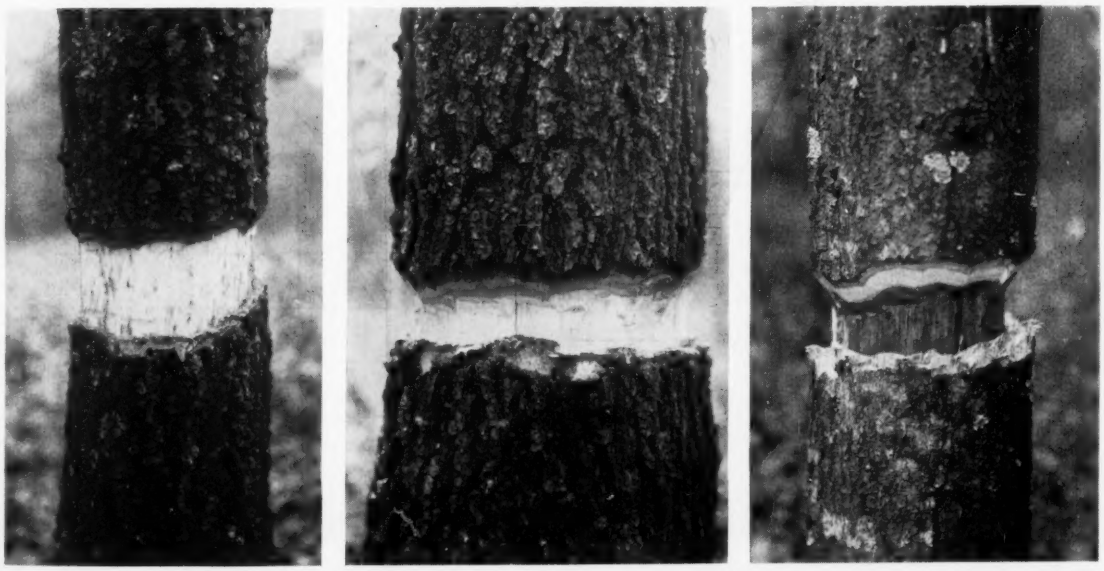


FIG. 1.—Depth-of-girdle treatments. *Left*, bark only removed; *Center*, bark and one chip of wood taken out; *Right*, sapwood completely severed.

Variation of Sampling Precision with Merchantability Classes in Relascope Estimates of Basal Area

A common timber cruising practice in the South is to tally trees in the 4- to 9-inch d.b.h. classes as pulpwood and trees in the 10-inch class and up as sawtimber. The results are then summarized and presented as cords per acre and board feet per acre, with the tacit implication that the two figures are equally valid, or approximately so. If the cordwood sampling precision is slightly less, that is considered acceptable because cordwood stumpage value is also somewhat less.

However, the percentage of trees in the stand which are of pulpwood size varies a great deal with mean stand diameter. This is shown in Figure 1 for two hypothetical stands in which the diameter distributions follow the normal probability curve. In stand A, mean d.b.h. is 10 inches, and 39.45 percent of the trees in the stand are of pulpwood size. In stand B mean d.b.h. is 20 inches, and only 0.55 percent of the trees are of pulpwood size, approximately 1/72 as many. It seems reasonable to assume that in actual practice the sampling precision attained may be very different for the two merchantability classes, pulpwood and sawtimber, and that relative precision will vary with stand mean diameter.

A study was made in 25 timber stands in southern Louisiana and Mississippi to determine how sampling precision actually varied. Relascope plots were located randomly in each stand, and on each plot the d.b.h. of "count" trees was measured with calipers to insure accuracy in allocating basal area to the proper merchantability class. Sampling precisions attained, as indicated by coefficients of variation were calculated for pulpwood and for sawtimber in each stand. The results obtained are shown in Figure 2. In a stand with mean d.b.h of 9.6 inches the sampling variation for pulpwood basal area was 2.2 times that of the sawtimber; stated conversely, sampling precision of the pulpwood was less than half that of the sawtimber. In a stand of 12.3 inches mean d.b.h., the sampling precision of the pulpwood was less than one-fourth that of the sawtimber. For the stands studied, the larger the average diameter, the larger the ratio of pulpwood variability to sawtimber variability.

The change in relative sampling precision with variation in stand mean diameter will vary with a number of factors, among them the width of the pulpwood class, the shape of the curve of diameter distribution, and the sampling technique used. It seems highly probable that use of the relascope, or any fixed-plot system which utilizes smaller plots for small trees than for large trees, would tend to increase the disparity between the sampling precisions attained for the two merchantability classes.

This study indicated that sampling precision, and therefore reliability, of pulpwood basal area may differ greatly from that of sawtimber basal area, and that the relative precision for pulpwood decreased with increase in stand mean diameter.

CHARLES B. BRISCOE,
GEORGE R. GUILLORY,
and O. KEITH BURCHFIELD
School of Forestry,
Louisiana State University,
Baton Rouge

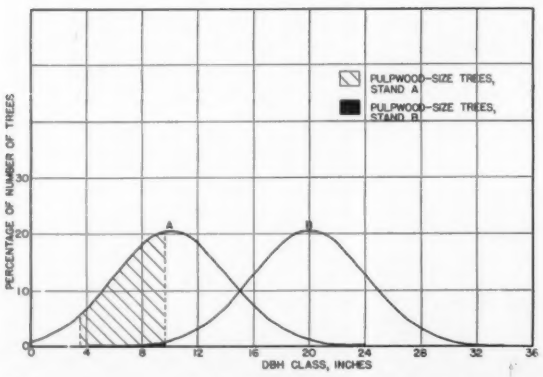


FIG. 1.—Percentage distribution of trees in a stand of normal diameter distribution. Stand A: mean d.b.h. 10 inches. Stand B: mean d.b.h. 20 inches.

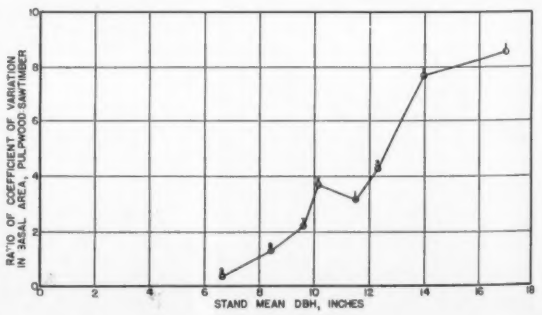


FIG. 2.—Relationship of variability in pulpwood timber to variability in sawtimber as a function of stand mean diameter.

Wound Area as Influenced By Closeness of Pruning[1]

Pruning techniques currently favored usually include the recommendation that the branches be cut close to the bole of the tree. It is generally recognized that close pruning in most species reduces the branch stub length, but increases the wound area, since the branch base tends to flare out at its junction with the bole. This enlargement is generally termed a "collar." Hawley and Clapp (*3*) recommended pruning outside this collar. Studies by Curtis (*2*), Moss (*4*), and Adams and Schneller (*1*) show that callus formation is stimulated by close pruning; in their opinion, the larger wounds would heal more quickly than smaller wounds resulting from pruning outside the branch base or collar. However, previous investigators did not determine relationships between pruning technique and resultant size of wound area.

How rapidly does wound area increase with a branch of given size as the pruning is done closer and closer to the bole? Quantitative data on this point should be helpful in formulating the most applicable pruning technique for a given species.

A study of pruning technique of white pine (*Pinus strobus* L.) and red pine (*P. resinosa* Ait.) in the W. K. Kellogg Forest near Battle Creek, Michigan, presented an opportunity to establish accurately the size of wound area as related to pruning technique. White and red pine are species commonly pruned in the Lake States region.

Methods

In this study, 24 white pine and 24 red pine trees 16 years old were selected. Half the trees of each species had living branches to be pruned, while the other half had branches which had been dead long enough for the branch base to be dead also. The sample trees in each category were as uniform as possible in diameter, height, length of crown, and branch size.

Numerous measurements were taken before and after pruning, but of concern here are the branch diameter and the wound area. Branch diameter was measured to the nearest 0.05-inch at a point 2 inches from the bole. The vertical and horizontal axes of each wound were measured to the nearest 0.05-inch between the inside edges of the bark. The wound area was then computed as the area of an ellipse.

Three pruning techniques were applied as follows:

Treatment A—The branch was cut off just outside the collar, leaving a very short stub.

Treatment B—The branch was cut close enough to definitely wound the collar all the way around the branch base.

Treatment C—The branch was cut as close to the bole as possible, removing all or most of the collar.

Each treatment was applied to all branches of one whorl on each tree.

Average wound areas by branch diameters, conditions, and treatments were tabulated, and these data were used to compute the regression of wound area on branch diameter for each species, condition, and treatment combination. Geometric considerations suggested an equation of the form

$$Y = ax^b$$

Where

Y is the wound area in square inches

a is a constant

x is the branch diameter in inches

b is the exponent of the branch diameter

Linear regression analysis can be employed to determine a and b. The branch diameter and resultant wound area are converted to logarithms, and the equation changed to the form

$$\text{Log } Y = a + b \log x.$$

With this procedure, the following equations were developed:

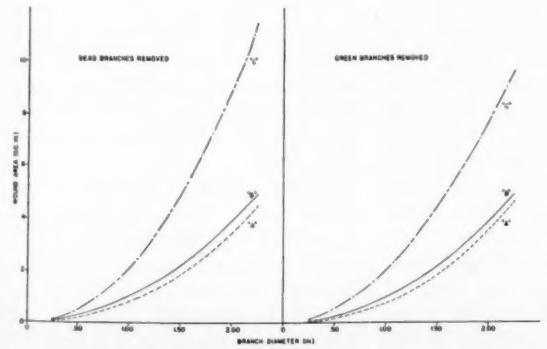


FIG. 1.—Relationship between branch size and wound area for three pruning techniques on red pine.

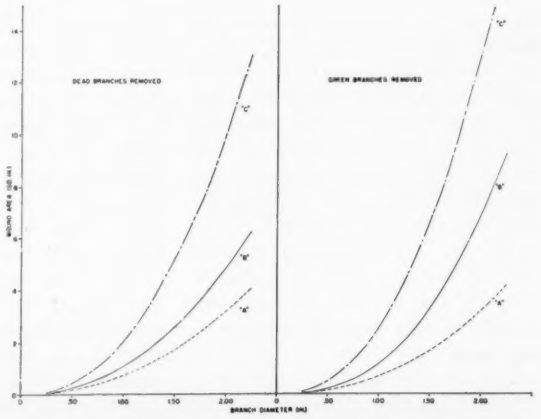


FIG. 2.—Relationship between branch size and wound area for three pruning techniques on white pine.

[1]Journal Article No. 2137 of the Michigan Agricultural Experiment Station.

Red pine, dead branches removed

Treatment A,	$Y = .781\, x^{2.147}$;	$\sigma\epsilon = .040$
Treatment B,	$Y = 1.023\, x^{1.929}$;	$\sigma\epsilon = .040$
Treatment C,	$Y = 2.085\, x^{2.097}$;	$\sigma\epsilon = .033$

Red pine, green branches removed

Treatment A,	$Y = .725\, x^{2.266}$;	$\sigma\epsilon = .029$
Treatment B,	$Y = .972\, x^{1.978}$;	$\sigma\epsilon = .073$
Treatment C,	$Y = 1.986\, x^{1.939}$;	$\sigma\epsilon = .069$

White pine, dead branches removed

Treatment A,	$Y = .729\, x^{2.117}$;	$\sigma\epsilon = .037$
Treatment B,	$Y = 1.077\, x^{2.162}$;	$\sigma\epsilon = .071$
Treatment C,	$Y = 2.026\, x^{2.303}$;	$\sigma\epsilon = .093$

White pine, green branches removed

Treatment A,	$Y = .673\, x^{2.249}$;	$\sigma\epsilon = .026$
Treatment B,	$Y = 1.159\, x^{2.563}$;	$\sigma\epsilon = .082$
Treatment C,	$Y = 2.510\, x^{2.378}$;	$\sigma\epsilon = .077$

The regression equations were solved to determine wound area for the desired range of branch diameters. The results are compared graphically in Figures 1 and 2.

With the same closeness of pruning, white pine has larger wound areas than red pine. This reflects the greater swelling of the branch base of white pine into a more distinct collar, and suggests the desirability of pruning white pine earlier than red pine if wound area is not to become excessive.

In routine pruning operations, relationships between pruning technique and resultant wound area will depend on the skill of the individual doing the pruning. However, the percentage increase in wound area as related to pruning technique should follow the trend shown in Figures 1 and 2. A comparison of the three techniques shows that there is a relatively small increase in wound area with Treatment B and a large increase with Treatment C. If close pruning as recommended by Curtis (*3*), Moss (*4*), and Adams and Schneller (*1*) to stimulate callus formation is desired, it appears that Treatment B offers the best compromise between closeness of pruning and wound size. Subsequent rate of healing and quality of the healing (such as pitch and bark pockets) will be followed, and will provide additional indications of the most desirable pruning technique.

Literature Cited

1. ADAMS, W. R., and M. R. SCHNELLER, 1939. Some physiological responses to close pruning of northern white pine. Vermont Agric. Expt. Sta. Bul. 444, 26 pp.
2. CURTIS, J. D., 1936. A method of pruning dead branches. For. Chron. 12: 291-299.
3. HAWLEY, R. C., and R. T. CLAPP, 1935. Artificial pruning in coniferous plantations. Yale Univ. School of Forestry, Bul. 39.
4. MOSS, A. E., 1937. Pruning second-growth hardwoods in Connecticut. Jour. Forestry 35: 823-828.

H. G. HERRING, V. J. RUDOLPH, and W. A. LEMMIEN[2]

[2]Respectively, graduate student and assistant professor of forestry, Michigan State University; forester-in-charge, W. K. Kellogg Forest, Augusta, Mich.

Incidence of Heart Rot in Mature Loblolly Pine in Coastal North Carolina

There is a scarcity of quantitative data on the incidence of heart rot in old-growth loblolly pine. Most of the existing second growth loblolly stands are under 80 years of age, and are being harvested before the trees become that old. Detailed measurements taken on old-growth loblolly pine during the construction of a local volume table for the Bigwoods Experimental Forest[1] provide information on the amount of heart rot found in this type of timber on one area.

[1]Maintained by the Southeastern Forest Experiment Station in cooperation with Union Bag-Camp Paper Corporation, Franklin, Virginia.

Two classes of old-growth stands were sampled. One was an old-field stand that averaged 89 years of age with a range from 74 to 106 years. This stand had been cut over very lightly for high-quality piling about eight years before the data were taken, but the trees had grown from seedlings to maturity with little disturbance. In the other area, where the land had never been cleared, there were many trees over 125 years of age, some over 200 years old, and there was also a younger age class of timber between 60 and 80 years old. The last known cutting in this stand was over 60 years ago when it was logged. There is some evidence that prior to that time charcoal and tar were produced from some species of pine. One loblolly pine was found growing on the rim of an old tar pit and when the tree was cut there were 140 growth rings on the stump.

When the two stands were logged, every tenth tree in each of the two stands was designated as a sample tree and all logs were scaled after felling. Table 1 shows the pertinent information gathered from these trees.

In the 30 decayed trees on the old-field site, 1 tree had heart rot in only 1 log, 14 trees had heart rot in 2 logs, and in the remaining 15 trees, rot occurred in 3 logs. In the 61 forest-grown trees, 6 had heart rot in 1 log, 29 in 2 logs, 17 in 3 logs, 7 in 4 logs, and 2 had heart rot in 5 logs. Of the 6 trees

TABLE 1.—PERTINENT INFORMATION REGARDING SAMPLE TREES

	Old-field stand	Forest-grown stand
Number of trees in sample	447	289
Gross volume in sample trees	169,990 bd. ft. (Int.)	128,880 bd. ft. (Int.)
Volume of average tree	356 bd. ft. (Int.)	446 bd. ft. (Int.)
Number of trees with heart rot	30	61
Percent of trees with heart rot	6.3%	21.1%
Gross volume of average trees with heart rot	261 bd. ft.	688 bd. ft.
Volume of defect	2,885 bd. ft. (Int.)	15,850 bd. ft. (Int.)
Percent of gross volume defective	1.7%	12.3%

TABLE 2.—AVERAGE SCALE FOR HEART-ROTTED TREES (INTERNATIONAL ¼″)

	Old-field stand (89 yrs.)			Forest-grown stand (125 yrs. +)		
	Gross scale	Heart rot scale		Gross scale	Heart rot scale	
	Bd. ft.	*Bd. ft.*	*Percent*	*Bd. ft.*	*Bd. ft.*	*Percent*
Butt log	96	26	27	230	95	41
Second log	76	38	50	189	92	49
Third log	55	22	40	146	54	37
Fourth log	28	9	32	91	18	20
Fifth log	6	1	17	32	1	3
	261	96	37	688	260	38

with a single log showing heart rot, 4 had rot in the butt log and 2 in top logs.

Heart rot, which in these stands was largely redheart (caused by *Fomes pini*), occurred most commonly in the second log (Table 2). This can be expected in view of the Hepting and Chapman[2] findings that this fungus usually gains entrance into southern pines through branch stubs and seldom through fire scars.

In the even-aged old-field stand the incidence of heart rot decreased as tree diameter and number of logs increased (Table 3). The average heart-rotted tree was 2 inches smaller in diameter than the average tree in the stand. In the more uneven-aged forest-grown stand, the incidence of heart rot increased with tree size. The average heart-rotted tree was 3 inches larger in diameter than the average tree in the stand. The larger trees in this stand were probably the suppressed, intermediate, or defective trees at the time the stand was originally cut. Many of these old growth trees show an area of very slow growth at the center followed by an extended period of good growth.

[2]Hepting, G. H., and A. D. Chapman. Losses from heart rot in two shortleaf and loblolly pine stands. Jour. Forestry 36 (12): 1193-1201. 1938.

TABLE 3.—OCCURRENCE OF HEART ROT ACCORDING TO NUMBER OF LOGS PER TREE

Number of 16-foot logs per tree	Trees containing heart rot	
	Forest-grown stand	Old-field stand
	Percent	*Percent*
1 and 2	7	3
3	14	12
4	23	6
5 or 6	37	4
	21	6

Although the average cull percentage was the same for affected trees in both stands of old growth timber (Table 2) there was a different pattern of occurrence of rot defect (Table 3). Defect was seldom confined to one log. Only one tree out of 91 affected trees appeared to have two points of infection. In this tree, which had five 16-foot logs, rot occurred in the bottom two logs and in the top two logs but was separated by a sound third log. The pattern of occurrence of heart rot in the trees examined in these old growth stands suggests that slow growth as well as old age contributed to the susceptibility of loblolly pine to heart rot.

GEORGE F. GRUSCHOW AND KENNETH B. TROUSDELL
Southeastern Forest Experiment Station, Forest Service, U. S. Department of Agriculture

Points of View

Basic Research—What Is It?

In a plea for basic research in forestry, Edward C. Stone offers definitions of both basic and applied research.[1] His article is timely and the argument for increasing the emphasis on basic research is laudable. But if different kinds of research are to be recognized in considerations of policies, needs, and programs, and possibly one kind favored over another, a clear understanding of what we are talking about is important.

Stone's definitions, in my opinion, do not fully provide such understandings. Specifically, I question the adequacy of his definition of basic research.

Stone describes basic or fundamental research as research that is "oriented toward determining why;" later he goes on to say that "the *only* criterion (of basic research) is whether the investigator is involved in an attempt to determine why" (italics mine). It is agreed that research oriented toward determining why is basic, and agreed also that much of the desired basic research in forestry would be so oriented. Such orientation, however, is not the only criterion of basic research. Definition in these terms is much too narrow.

In his first example, intended to show what constitutes basic research, Stone paints himself into a corner—he ends up with a piece of research that, by his own definitions, is neither basic nor applied. The example involves two researchers studying the chemical constituents of several kinds of wood, one seeking to identify the compounds present in each wood, the other seeking a why answer to a question of wood decay. The latter obviously is doing basic work. Stone says the first, by merely cataloging, is doing only "non-basic" research. Elsewhere in the article he says that non-basic research is generally accepted as a synonym for applied research, and defines applied research in terms of "applicability of the results to a present-day operational problem."

Now, the cataloger has no operational problem; hence he cannot be doing applied research. Therefore, if non-basic and applied are truly synonymous, the work of the cataloger is left dangling without a label under Stone's definitions. If we weasel a bit by saying the two terms are not always synonymous, it is still begging the question to label the cataloger's work as non-basic. If a piece of research is not basic and not applied, what kind of research is it?

To answer this question we must either set up a third category or else recognize a broader definition of basic research than "orientation toward d e t e r m i n i n g why." A broader definition is in accord with most present-day usage wherein all research commonly is classified either as basic or applied. The concept of basic under the two-class system must therefore include what has sometimes been called "pure" research, i.e., research for its own sake, as a contribution to human knowledge, unrelated to operational problems or to the why questions posed by those problems. Under this concept, the cataloger of the chemicals in woods was doing basic research.

Hard Heads Or Atom Bombs

We should not sell short those investigations that are inspired purely and simply by curiosity or by consuming academic interest devoid of practical considerations. Some people—notably some "hard-headed" men of business and industry—are inclined to regard such research as frittering away time and money. But let us not forget that all the classical sciences have been founded largely on such research.

Academic investigations have a habit of leading to very practical developments. Who foresaw atomic bombs and nuclear power when Lord Rutherford and others of his era began to pry into the structure of the atom? Or when Einstein propounded $E = MC^2$? Coming closer to foresters' experience, who foresaw rooting compounds, delayed abscission, prolonged dormancy, herbicides, and silvicides when botanists discovered and began experimenting with natural and synthetic plant hormones?

The early investigations of the atom, of plant hormones, and many others of similar character were undeniably basic research. The motivation or orientation for such research runs the whole gamut of interrogatives, of which *why* is but one.

In What Niche?

To cite some simpler examples of research that is neither applied nor why-motivated:

A forest entomologist might become interested in a little-known insect of no apparent economic importance, and work out its life cycle and feeding habits. A parallel example could of course be drawn from the field of forest pathology.

A forester or ecologist might reconstruct the history and work out the successional relationship of a stand or timber type. Under some circumstances this might be why-oriented; under others it might be applied research: but it would be neither if the investigator's main interest were simply in the successional relationships.

A forester or physiologist might study the effects of photo-period upon growth of tree seedlings. Like the preceding example, this might be why-oriented or it might be applied research; but it would be

[1]Stone, Edward C. Basic research in the biological aspects of forestry. Jour. Forestry 55:672-673. 1957.

neither if the main interest were simply in learning how different species respond to different light treatments.

A forester or physiologist might investigate the mechanism of the entry of chemicals such as 2,4,5-T into plant leaves or stems. If the main interest is the mechanism or process, the research is neither why-oriented nor applied.

The Primary Purpose

Research such as exemplified above, or any research of whatever subject or scope, if done without applicability to an operational problem, is basic research regardless of the orientation or motivation, regardless of foreseeable practical significance, and regardless of whether it simply contributes another item in an established field of study, or whether it opens a completely new vista in science. It is basic because the primary purpose and primary end are to add to the total of scientific knowledge.

Kaufert and Cummings[2] quote the National Science Foundation as follows: "Basic research is the type of research that is directed towards the increase of knowledge of science." Also: "Basic research leads to new knowledge. It provides scientific capital."

These definitions obviously include much more than just why-oriented research. In general they cover all research that does not qualify as applied, and as such they are more realistic and useful concepts than the restrictive one offered by Stone.

W. E. MCQUILKIN
Northeastern Forest Experiment Station, Forest Service, U. S. Department of Agriculture

[2]Kaufert, Frank H., and William H. Cummings. Forestry and related research in North America. 280 pp. Soc. Amer. Foresters, Washington, D. C. 1955. (See p. 48.)

More on Basic Research

In the September issue of the JOURNAL my namesake, Dr. Edward C. Stone, argues eloquently in favor of "basic" research in the biological aspects of forestry. By his definition, "basic" or fundamental research differs from "non-basic" not in applicability but in its concern with *why*, that is, with causes.[1] "Applied" research then, may be either basic or non-basic. It is a mistake, he holds, to attack applied problems through "non-basic" approaches when, as in forestry, the existing state of knowledge is not well developed and the number of investigators relatively small.

The present writer has been party to many late evening arguments, wherein pure, basic, theoretical, fundamental, ivory tower, academic, and impractical research were ranged against the applied, non-basic, empirical, developmental, utilitarian, and practical. These words and distinctions meant, of course, exactly what the user intended them to mean, though it often appeared that one man's basic was another man's applied. A Stephen Potter witnessing such debates might have described with gleeful malice how Einstein-the-Pure and Edison-the-Practical had become rival patron saints for hosts of humbler followers seeking the true faith and blessing for their own efforts.

Most such discussions ceased to be meaningful for the writer about 10 years ago after reading James Conant's reflections on science and the practical arts. These are given, in part, in his address as retiring president of the American Association for the Advancement of Science (Science 107 (2769) 77-83, 1948). The various fields of science, said Conant, differ greatly in their degree of empiricism. In some, like many aspects of physics and chemistry, theory has wide applicability and the degree of empiricism is low. Whether the motive be pure or otherwise, the attack on a problem can be exceedingly fundamental. In other fields, such as chemotherapy, concept and theory have only limited applicability, as yet. For lack of these new drugs are still discovered by cut and try methods, but no one suggests that such research should halt because of its non-basic and highly empirical nature.

Much of forestry and forest research is also plainly empirical today, and hence some of Dr. Conant's further statements have a particular relevance for forest researchers, research administrators, and would-be users of the results:

". . . unless progress is made in reducing the degree of empiricism in any area, the rate of advance of the practical arts connected with that area will be relatively slow and highly capricious . . ."

"Therefore, rather than debate endlessly about pure and applied science, we might do well to emphasize the need for more satisfactory and wider conceptional schemes in almost every field. Recognizing that some practical problems cannot wait on the outcome of efforts to lower the degrees of empiricism of the science in question, nevertheless, we can hope that not too large a share of scientific effort will be directed to immediate ends. The history of science shows, I believe, that at times a wider understanding has come about by piling up of new but limited concepts, each representing but a slight advance, yet, when taken together over several decades, making a highly significant improvement in the scheme. Sometimes these new developments have been intimately associated with the solution of practical problems . . . At other times this approach has been relatively unsuccessful, and only by considering the problems in splendid isolation from any practical considerations were the new concepts evolved which later proved to be of enormous practical significance."

Perhaps our test of good forest research should be not whether it is basic or non-basic but, rather is it relevant; is it well done; will it reduce the degree of empiricism in its area?

EARL L. STONE, JR.
New York State College of Agriculture, Ithaca

[1]Stone, Edward C. Basic research in the biological aspects of forestry. Jour. Forestry 55: 672-673. 1957.

Reviews

The Federal Lands, Their Use and Management

By Marion Clawson and Burnell Held. 536 pp., Illus., The Johns Hopkins Press, Baltimore, Md. $8.50.

The acquisition, disposition, use, and management of federal lands have had, and will continue to have, an impact, direct or indirect, on every United States citizen. Thus, it is a subject in which all should be interested and upon which greater understanding is needed. For this reason this book should be widely read. It will be of particular interest to college students, teachers of conservation, policy makers, and that portion of the general public who have the interest and inclination to take an active part in matters relating to resource management and the interrelations of uses.

The authors, who are on the staff of Resources for the Future, Inc., by whom this book is sponsored, have had wide experience and technical training in the field of public land policy and are eminently qualified to write on the subject. As a result, the material presented is objective, authoritative, and factually accurate. Although the subject is profound and complex, both the writing style and the organization of the material are commendable, which makes for interesting reading and ease of comprehension.

The analysis of historical information and basic physical data, and the interpretation of the underlying social philosophies have led the authors to the assumption that there will be no major changes in federal land ownership in the foreseeable future. They believe that the real problem is not one of large-scale disposal or acquisition, but one of developing policies which will result in better management and wiser use of areas now federally owned.

The book consists of an introduction, six chapters, and appendices. Throughout, it is excellently illustrated with photographs, maps, tables, and graphs, all of which help the reader materially. As a further aid, the appendices contain additional statistical information, and a section on laws and regulations, which could not be conveniently woven into the body of the text.

The content of the book is based upon a study wherein the authors examine from the historical and economic viewpoints many important questions and problems relating to federal lands. History is not discussed for history's sake, but because it is felt that the lessons of the past have relevance for the future. Further, the historical treatment given helps the reader understand that many situations which may appear illogical today have a history which accounts for their origin, even if it does not explain their rationale.

Some of the important trends discussed have to do with the rapidly increasing demands for use of federal lands and the resulting increases in revenues, costs, and investments. The analysis and interpretation of these trends is one of the most important contributions, and influences naturally the conclusions reached. The factors influencing the pricing process for the sale of federal lands and products are given careful study by the authors. The relative influence of economic forces and political actions on the pricing process and market form is considered. They conclude that in total the process works badly from the standpoint of determining appropriate allocations among uses and users and by keeping prices, revenues, and investments lower than they should be, all of which cause lower than maximum total productivity.

The chapters dealing with policy formation and decision-making, past, present, and for the future, offer much which should stimulate thought and action leading to the solution of some evident problems. In these chapters the authors, drawing upon their thorough study and analysis presented in other chapters and upon their own broad experience, present a number of alternative ideas and viewpoints for dealing with federal lands in the future.

It is evident that they question whether federal land policies and administrative procedures have kept pace with the dynamics of our society and economy.

ERNEST WOHLETZ
Dean, College of Forestry, University of Idaho

British Commonwealth Forest Terminology Part II—Forest Products Research Extraction, Utilization and Trade

The Empire Forestry Association, At/The Royal Empire Society, London. 230 pp. Illus. 1957. Price 30/-.

Part I of this series covered the terminology of silviculture, protection, mensuration, and management and was published in 1953. Part II is the culmination of some 20 years of effort, primarily under the chairmanships of, first, Mr. T.

A. McElhanney and, second, Col. J. H. Jenkins, both of whom served as chief of the Forest Products Laboratories of Canada. Col. Jenkins is the present chief of those Laboratories.

Contributions to Part II have been made by representatives of all members of the British Commonwealth (26 in total), with the result that this work should assume the position of an outstanding English-language reference in its field. Assistance was given also by the Terminology Committee of the International Association of Wood Anatomists. The Society of American Foresters gave permission to borrow from its *Forestry Terminology* (Revised 1950), and about 300 definitions have been used from that source.

Part II contains definitions of some 2,400 words and terms, in contrast to 1,700 items defined in Part I. Arrangement-wise, most words and terms have been combined into a single alphabetical list. Plural-word terms are located alphabetically under the key word; e.g., "Jack, log." However, there has been some grouping of terms and words under closely related subject headings such as under "Figure," "Kiln, drying," "Log rules," and "Preservation wood." Words and terms so grouped are also listed alphabetically and carefully cross-referenced to the group.

In scope, Part II is limited, generally, to forestry, products, processing, and research terms used from harvesting through the stage of primary conversion. Therefore, the U. S. reader will be unable to find a definition of secondary products, such as "shunt pole," but will have no difficulty finding "deal," "pitwood," and "sleeper." Incidentally he will find that the U. S. counterparts of "sleeper" (crosstie) and of "pitwood" (mine timbers) also have been included in this reference.

The *Terminology* should be a valuable tool to those who have professional or commercial relations with the British Commonwealth or with its literature. Although a liberal number of definitions covering U. S. words and terms have been included, apparently it is not intended that this reference will otherwise serve a widespread need in this country. Certain basic differences between British and American spellings (e.g., "tyre" for "tire") and definitions (e.g., the British use of "timber" as a class name for all sizes of sawn products) are minor factors militating against wide use of the reference in the United States. Perhaps the words and terms applicable to research are most useful to American readers, since English-speaking research workers use a more nearly universal language than do the logging and processing industries.

In addition to its major purposes of furnishing information on English language word and term definition and of encouraging standard word usage throughout the British Commonwealth, this work represents an important step forward toward a major international FAO objective—the preparation of an International Forest Terminology Dictionary. The next phase of working toward this objective is the compilation of terminology for the English-speaking world, to be undertaken by the Terminology Committees of the Empire Forestry Association and the Society of American Foresters.

CLAUDE C. BELL
Forest Products Laboratory, U. S. Forest Service

The Experimental Control of Plant Growth

By F. W. Went. 336 pp. Illus. Chronica Botanica, Waltham, Mass. 1957. $8.50.

Scientific progress is closely allied to equipment development. As new tools are produced, hypotheses whose only respectability has come through old age are quickly disposed of; others are substantiated; and new ones are formulated. Progress in atomic physics, use of isotopes in biological studies, and information on the structure of the cell wall, to name but a few, are the direct result of equipment development—the cyclotron, the Geiger counter, and the electron microscope.

Recently under the careful hands of Professor F. W. Went, at the California Institute of Technology, the "Phytotron" has taken shape. In essence it is a number of plant growth chambers in which certain facets of the environment are controlled. As a tool it can be as important to the plant physiologist, the plant ecologist, and subsequently to the practicing forester as the cyclotron has been to the physicist. For example, Clements' contention that the vegetation is the best measure of the climate—a concept familiar to all foresters and considered axiomatic by some—can now be evaluated.

The history of its development, a detailed description of its mechanics, and a discussion of experiments already completed in the "Phytotron" makes up the theme of *The Experimental Control of Plant Growth.* The first five chapters report on the details of construction and operation. The next nine chapters report on the climatic response of individual plants and are written by individuals who have carried on the research in the "Phytotron." Of particular interest to foresters is the chapter by Hellmers, a forest physiologist working for the U. S. Forest Service on chaparral plants. The last 12 chapters are a general discussion and run the gamut from genotypic and phenotypic variability, to the effect of smog.

This is a highly readable book, well illustrated, and should be required reading by all those concerned with the biological aspects of forestry, particularly by the research administrator who will determine how soon the rest of us will have such facilities.

EDWARD C. STONE
School of Forestry, University of California

River Basin Development

322 pp. Illus. Law and Contemporary Problems, Duke University Press, Durham, North Carolina. 1957.

In this symposium, nine qualified observers analyze the development of water resource management in this country, the plans used to foster it, and the techniques used to evaluate it. They also examine the basic laws governing water conservation and use, and make some recommendations for the future.

Dr. Gilbert F. White, professor of geography at the University of Chicago, sets the stage by classifying river development projects in this country and abroad. Sixty years of water management evolution in the United States brings him to these conclusions: Multiple-storage, once considered doubtful, is now fully accepted by engineers; unified basin development, while accepted in theory, has had meager application; comprehensive regional development is sorely hampered by the difficulties of identifying and measuring regional growth benefits; controlling water through land management is a popular idea but rarely applied; the idea of unified administration, as practiced in the Tennessee and Rhone valleys, has inspired more controversy than imitation; lack of tools for measuring the results of basin development is perhaps the greatest obstacle to more widespread application.

Dr. Arno T. Lenz, professor of hydraulic engineering at the University of Wisconsin, discusses the engineer's role in collecting basic hydrologic and physiographic data and the use of these data in water control.

Dr. William E. Folz, professor and chairman, Department of Agricultural Economics, University of Idaho, laments the lack of tools for measuring the effects of resource development on economic expansion. He credits the opening of additional farm land through irrigation as most conducive to economic expansion. Development of additional electric power, he says, will not trigger industrial expansion except perhaps under full-employment conditions. He contends that water transportation has long ceased to be a factor in plant location and that flood control and recreational benefits are not prime movers. Basin development, he concludes, cannot compete with such powerful expansion motivators as war, large public investments, and discovery of valuable mineral deposits. He states further that any expansion resulting from basin development is likely to result in competition trade and that the national net effect may be negative.

Carl F. Kraenzel, professor of rural sociology at Montana State College, describes the United States as a highly urbanized, industrial-commercial society dominated by a few large urban centers. The river basin development idea is proposed as a way to curb this dominance and give outlying residents and communities a positive voice in the decisions that affect them. The Tennessee Valley, which has such centers, and the Missouri Valley, which does not, are critically examined for social consequences resulting from development projects.

Dr. Hubert Marshall, assistant professor of political science, Stanford University, examines the methods used to justify river development projects and concludes that they do not now contribute to rational comparison of alternatives for budgeting purposes. The financial feasibility method used by the Bureau of Reclamation is based on the ability of water users to repay capital costs. The time was originally ten years but has been gradually increased to 50 years. Even so, few projects can pay out in 50 years and most project repayment periods have been lengthened. The benefit-cost analysis method used by the Corps of Engineers and the Department of Agriculture is misused to the extent that it provides little reliable information to guide congressional action. Marshall believes, however, that it could contribute to rational decision-making if evaluation were the responsibility of a strong independent unit in the Executive Office of the President.

Dr. Norman Wengert, professor of government and politics, University of Maryland, analyzes the process of governmental decision-making and discusses the pressures brought to bear on basin development questions. There are groups like the conservationists, those that derive direct financial benefits, and government agencies with programs to sell. There are the mass interest slogans and symbols based on such concepts as exploitation, water famine, floods, and pollution. There are the controversies raised by where to draw regional lines, upstream and downstream interests, who shall benefit, and basin boundaries versus political and economic boundaries. And there is the ever-present competition for funds between resource development and all of the other functions of government.

Wells A. Hutchins and Harry A. Steele of the U. S. Department of Agriculture trace the origin of American water law and discuss the advantages of riparian and prior appropriation water rights. They conclude that riparian rights are outmoded and recommend a modification of western appropriative rights. They predict that in the future, individual water rights will not be granted by the states but rather by water management districts which hold mass water rights in trust for the users.

Frank J. Trelease, professor of law, University of Wyoming, attempts to identify the requisites of a model state water code, assuming that water is scarce and that choice must be made among competing uses. He, too, accepts prior appropriation as the best existing system of law for river basin development. A model law, he says, should encourage maximum development. It should guarantee security of water rights for those who invest in facilities and yet be flexible enough to encourage progress. It should protect the public against destructive exploitation of the water resource and the deterioration of such public uses as navigation, fishing, and recreation. It

should somehow solve the problem of unused riparian rights where they tend to deter future expansion.

Foresters who are interested in water and watershed management will find this symposium a valuable reference. It is not easy reading but is rewarding in view of the great public controversy over how water resources shall be developed, by whom, at whose expense, and for whose benefit.

J. O. Artman
Tennessee Valley Authority

Economics of Under-Developed Countries

By Peter T. Bauer and Basil S. Yamey. 271 pp. The University of Chicago Press, Chicago. 1957. $2.25.

Those American foresters who move into foreign service in the under-developed areas which have some three-fourths of the world's population will become acutely aware of the compelling problem of economic growth which affects their every action. In an effort to increase their understanding of the economic environment in which they find themselves, they may well turn to this recent publication in the widely respected series of Cambridge Economic Handbooks.

They will find here no easy and specious solutions nor a special economics. Instead, they will find traditional and orthodox economic analysis applied rigorously to the particular circumstances of the under-developed nations. The currently fashionable emphasis on capital shortages is restored to perspective by consistent recognition that "productivity of resources depends upon the availability of complementary resources." "Conservation" is handled in almost peremptory fashion on the grounds that "there is no economic merit in conservation as such; its merit depends on particular economic circumstances." In general, foresters will find here a model of logical consistency which will increase their understanding of the economy of the United States as well as of the under-developed areas.

Although the book is advertised as written for the general student as well as for the economist, it assumes familiarity with basic economic analysis and terminology. Indeed, despite the straight-forward presentation, some degree of economic sophistication would be helpful to the reader.

John A. Zivnuska
University of California

Publications of Interest

Career Opportunities in B.L.M. for Foresters describes trainee positions available to professional foresters with the Bureau and the advantages of Civil Service employment. With the pamphlet is an announcement of examinations for seasonal employment, mostly in Washington, Oregon, California, Idaho, Utah, Nevada, Arizona, Montana, Wyoming, Colorado, New Mexico, or Alaska. Requests for copies and other questions concerning forestry careers with BLM should be addressed to the Placement Officer, Bureau of Land Management, U. S. Department of the Interior, Washington 25, D. C.

* * *

The Department of Commerce submitted to the Interstate and Foreign Commerce Committee, House of Representatives, at a public hearing on June 17, 1957, the report *Pulp, Paper and Board Supply-Demand* (*House Report No. 573*) requested by the Committee and prepared under the direction of the Forest Products Division, Business and Defense Services Administration.

This report represents the first study ever prepared by the Department of Commerce for public use which analyzes projected future supply and demand in terms of principal products for one of the nation's major manufacturing industries. It should be of considerable interest, not alone to pulp, paper, and paperboard companies, but also to paper converters and to various printing and publishing establishments. Many other types of business firms, including wholesale paper merchants, exporters and importers, should likewise find the report useful.

Copies of House Report No. 573 are available from Superintendent of Documents, Government Printing Office, at 55 cents per copy domestic; 70 cents foreign.

* * *

Recently published by Dover Publications, Inc., is a 1957 edition of W. M. Harlows *Trees,* a work first published in 1942 under the title *Trees of Eastern United States and Canada.* The 288-page paper bound book is directed not to the specialist but to the intelligent layman who is truly interested in trees. The author describes more than 140 different trees with regard to appearance, habitat, commercial use, and woodlore. Copies are available from the publisher at $1.35 each.

* * *

Lumber Industry Facts 1957 is published by the National Lumber Manufacturers Association, 1319 - 18th St., N.W., Washington 6, D. C. This 48-page pamphlet contains a wealth of statistics on lumber production, forest resources, consumption and utilization, employment, and other pertinent subjects. No price indicated.

* * *

The Pesticide Problem: A brief review of present knowledge and sugestions for action was prepared for the Conservation Foundation and the New York Zoological Society by Dr. John L. George, associate curator of mammals, New York Zoological Park. The 67-page mimeographed publication reviews the background of pesticide use, the reasons for tremendous growth in such use, and the past findings of the effects on flora and fauna. It recommends a research program to supply greater information, particularly on long term ecological effects. The address of the Conservation Foundation, publisher of the report, is 30 East 40th St., New York 16. No price indicated.

* * *

Available from the Forest Service is a recently released listing of Forest Service films available on loan for educational purposes. The booklet lists 16- and/or 35-mm. sound films, many of which have been cleared for TV use. Teachers may get a copy free from the Forest Service, Washington 25, D. C. or from any Forest Service office.

Current Literature

Compiled by MARTHA MEELIG, *Librarian, State University College of Forestry at Syracuse University*

Range Management Section Compiled by Division of Bibliography, Library, U. S. Department of Agriculture

General

A Forest Policy for Kenya. 9 pp. Kenya Ministry of Forest Development, Game & Fisheries, Nairobi. 1957. White Paper No. 85.

Forests in Rural Development. Illus. folder. Committee for Rural Development Program. U. S. Forest Serv., Washington 25, D. C. 1957. Rural Resources Leaflet No. 2.

Forest Economics

he Continuous Yield of Our Forests. By L. J. Markwardt. 10 pp. Charts. U. S. Forest Products Lab., Madison, Wis. 1957. Rept. No. 2099.

Market Prospects for Mountain States Timber. By S. B. Hutchinson. 28 pp. Illus. Intermountain Forest & Range Expt. Sta., Ogden, Utah. 1957. Research Paper No. 50.

Forest Management

Influence of Ownership and Size Structure on Forest Management in Sweden. By Thorsten Streyffert. 44 pp. Royal School of Forestry, Stockholm. 1957. Bul. No. 23b. kr. 41—.

Pole Grower's Guide. By H. L. Williston. 34 pp. Southern Forest Expt. Sta., New Orleans. 1957. Occ. Paper No. 153.

Forest Products

1956 Pulpwood Production in the South. By J. F. Christopher and M. E. Nelson. 15 pp. Southern Forest Expt. Sta., New Orleans. 1957. For. Survey Release No. 80.

Production and Plant Receipts of Veneer Logs in California 1956. By R. H. May. 7 pp. California Forest & Range Expt. Sta., Berkeley. 1957. For. Survey Release No. 27.

Forest Resources

Forest Inventory Statistics for Franklin County, Tennessee. 18 pp. TVA, Norris. 1957. Forestry Bul. No. 52.

Forest Inventory Statistics for Washington County, Virginia. 18 pp. TVA, Norris. 1957. Forestry Bul. No. 55.

Forest Resources and Forest Industries of Lane County, Oregon. 117 pp. Illus. Pacific Northwest Forest & Range Expt. Sta., Portland, Ore. 1957. For. Survey Rept. No. 131.

Forest Statistics for Snohomish Co., Washington. By Benjamin Spade and J. T. Bones. 30 pp. Pacific Northwest Forest & Range Expt. Sta., Portland, Ore. 1957. For. Survey Rept. No. 128.

Forest Statistics for the Piedmont of Virginia, 1957. By M. B. Bryan. 52 pp. Southeastern Forest Expt. Sta., Asheville, N. C. 1957. For. Survey Release No. 51.

Logging and Milling

Saw-Log Barkers. By E. W. Fobes. 10 pp. U. S. Forest Products Lab., Madison, Wis. 1957. Rept. No. 2091.

Protection

The Balsam Woolly Aphid. 7 pp. Illus. Canada Dept. of Agric. Sci. Serv. For. Biol. Div., Ottawa. 1956. Publ. No. 977.

Biology and Control of the Douglas-Fir Beetle in the Interior of British Columbia. By. J. Walters. 11 pp. Illus. Canada Dept. of Agric. Sci. Serv. For. Biol. Div., Ottawa. 1956. Publ. No. 975.

The Fir Engraver, a Serious Enemy of Western True Firs. By G. R. Struble. 18 pp. Illus. U. S. Dept. of Agric., Washington 25, D. C. 1957. Production Research Rept. No. 11. 15 cents (Govt. Print. Off.).

The Genus Tenuipalpus *in Mexico.* By Donald De Leon. pp. 81-93. Illus. Reprinted from The Florida Entomologist, Sept., 1957. Author, Pensacola, N. C.

Influence of the Forest Tent Caterpillar Upon the Aspen Forests of Minnesota. 45 pp. Illus. Office of Iron Range Resources and Rehabilitation, St. Paul 1, Minn. 1956.

Silviculture

Experiments with Root and Top Pruning of White Spruce Nursery Stock. By R. E. Mullin. 31 pp. Ontario Dept. of Lands & Forests, Toronto. 1957. Research Rept. No. 36.

Frost Hardiness of White Spruce and Red Pine Seedlings in Relation to Soil Moisture. By J. W. Fraser and J. L. Farrar. 5 pp. Canada Dept. of Northern Affairs & Nat'l. Res., For. Branch. Ottawa. 1957. Tech. Note No. 59.

Growth and Survival of Experimental Plantations of Douglas Fir. By H. Knight. 22 pp. Illus. British Columbia Forest Serv., Victoria. 1957. Research Notes No. 33.

Silvical Characteristics of Black Oak. By K. A. Brinkman. 14 pp. Illus. Central States Forest Expt. Sta., Columbus, Ohio. 1957. Misc. Release No. 19.

Silvical Characteristics of Pin Oak. By L. S. Minckler. 10 pp. Illus. Central States Forest Expt. Sta., Columbus, Ohio. 1957. Misc. Release No. 20.

Silvical Characteristics of Quaking Aspen. By R. O. Strothmann and Z. A. Zasada. 26 pp. Illus. Lake State Forest Expt. Sta., St. Paul, Minn. 1957. Sta. Paper No. 49.

Silvical Characteristics of Shellbark Hickory. By R. W. Merz. 14 pp. Central States Forest Expt. Sta., Columbus, Ohio. 1957. Misc. Release No. 18.

Studies of the Root Systems of Deciduous Trees. By B. B. Stout. 45 pp. Illus. Black Rock Forest, Cornwall-on-the-Hudson. 1956. Bul. No. 15. 50 cents.

Wood Preservation

Longer Life for Wood in Your Fencelines and Vineyards. By L. S. Hamilton and G. R. Cunningham. 24 pp. Illus. New York State College of Agric., Ithaca. 1957. Cornell Ext. Bul. No. 987.

The Toxicity of Arsenical Compounds to Microorganisms. By R. A. Zabel and F. W. O'Neil. pp. 911-914. Reprinted from TAPPI, Nov., 1957. Available from authors, State Univ. Coll. of Forestry, Syracuse 10, N. Y.

Wood Technology and Utilization

Relationship of Locality and Rate of Growth to Density and Strength of Douglas-Fir. By J. T. Drow. 56 pp. U. S. Forest Products Lab., Madison, Wis. 1957. Rept. No. 2078. Mimeog.

Second Growth is Good. By B. H. Paul. 6 pp. Illus. U. S. Forest Products Lab., Madison, Wis. 1957. Rept. No. 2083. Mimeog.

Timber Identification for the Builder and Architect. By N. Clifford. 141 pp. Illus. Leonard Hill, Ltd., London. 1957. 37s 6d.

NEW

...Another Logging Champion Wears the John Deere Name

Ruggedness, power, operator's comfort, and all-around economy are featured in the new "440" Crawler.

The JOHN DEERE "440" Crawler

Here it is . . . trim and eager and out for timber—the tractor that's bound to win the nods of the "hard hats" from one end of the woods to the other—the New John Deere "440" Crawler!

The "440" is all it looks to be—and more! It is rugged in its modern construction . . . powerful in its let's-get-to-work styling . . . and it literally shouts economy at the moment of purchase and all the while that it is paying you back many times in extra-low production costs.

"Born" for logging, the "440" is built around an amazingly efficient, precision-tooled John Deere engine, unmatched for delivering so much, for so long, for so little cost. Its many construction features of hood, grille, frame, power train, and track assembly—plus the optional new clutch-type direction reverser—give the "440" its rare combination of maneuverability, lugging power, and stamina that enable it to do more than its share of the logging day's rough work. Clean, modern, functional design throughout makes the "440" businesslike in operation, easy to service, and economical to maintain. A line of proved, matched working equipment gives the "440" the versatility that logging demands.

Worthy "Stablemate" of the Popular "420"

Every inch another "thoroughbred," the new John Deere "440 is a worthy "stablemate" of the ever popular John Deere "420," the busy, capable, and economical Crawler that continues to merit the praises of efficiency-minded loggers everywhere.

With a capacity for work that must be seen to be believed, combined with a nimbleness that cuts maneuvering time drastically, both of these tractors have the ability to squeeze more work out of every piece of equipment and to press more work into every hour.

"Especially Engineered for the Woodlands"

JOHN DEERE Industrial

SEND FOR FREE LITERATURE

JOHN DEERE • INDUSTRIAL DIVISION
Moline, Illinois • Dept D 78 C

Please send me information on:
- ☐ "440" Crawler
- ☐ "420" Crawler

Name_____

Address_____

City_____

State_____

Society Affairs

Officers and Council
1958-1959

GEORGE A. GARRATT, *President*
School of Forestry
Yale University
New Haven 11, Conn.

B. E. ALLEN
Union Bag-Camp Paper Corporation
P. O. Box 570
Savannah, Ga.

PHILIP A. BRIEGLEB
Southern Forest Experiment Station
704 Lowich Building
2026 St. Charles Avenue
New Orleans 13, La.

DONALD E. CLARK
U. S. Forest Service
Federal Center, Building 85
Denver 7, Colo.

HENRY J. MALSBERGER, *Vice President*
Southern Pulpwood Conservation Association
900 Peachtree Street, N. E.
Atlanta 9, Ga.

CHARLES A. CONNAUGHTON
U. S. Forest Service
630 Sansome Street
San Francisco 11, Calif.

KENNETH P. DAVIS
School of Natural Resources
University of Michigan
Ann Arbor, Mich.

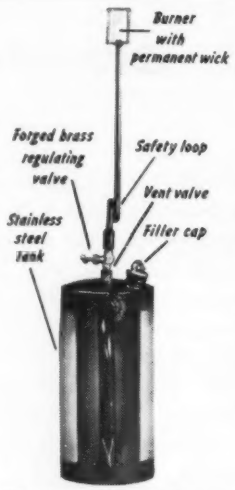
MAURICE K. GODDARD
Department of Forests and Waters
Harrisburg, Pa.

HENRY CLEPPER, *Executive Secretary*
Mills Building, 17th Street at Pennsylvania Avenue, N. W.
Washington 6, D. C.

WILLIAM D. HAGENSTEIN
Industrial Forestry Association
1410 S. W. Morrison Street
Portland 5, Ore.

J. HERBERT STONE
U. S. Forest Service
729 N. E. Oregon Street
Portland 8, Ore.

HENRY J. VAUX
School of Forestry
University of California
Berkeley 4, Calif.



PANAMA
STAINLESS STEEL
DRIP TORCH

This new Drip Torch is made of light weight but *extremely tough* STAINLESS STEEL metal. It is designed to withstand the rough treatment that drip torches get. It will give long and satisfactory service.

The safety loop is well away from the flame so there is no danger of the fuel in the loop (liquid seal) vaporizing from heat.

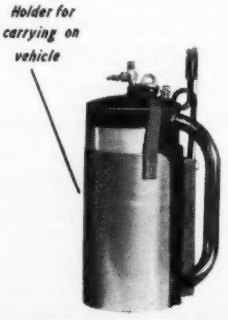
The Forged Brass regulating Valve enables the operator to accurately gauge the amount of fuel required as not all back-firing conditions require the same amount of fuel.

The screw type vent valve introduces air to the bottom of the Tank to relieve the vacuum created when fuel is being used.

The wick is made of wire inserted flat braided asbestos and is riveted in.

The "Hand fitting" handle gives very good balance in any position.

Nozzle with loop can be removed for stowing or packing.



CAPACITY	WEIGHT	PRICE
1-3/8 GALS.	4 lbs.	$19.80

A good torch deserves a good Holder. The Holder at right can be bolted to the bed of the vehicle for safe and convenient and compact transportation. Price of Holder $5.00.

PANAMA PUMP COMPANY
Hattiesburg P O Box 689 Mississippi

'Airlift' of Dow chemicals releases pines for more profit

This airplane's mission is profit. It's applying a vegetation control Dow chemical to knock out overtopping hardwoods and permit the harvesting of more pine sawtimber or pulpwood . . . earlier.

Aerial application of Esteron® 245 O.S. is the low-cost way to speed up the growing schedule of young pines. It's easier and faster, too. But you won't have to sacrifice results. Not when you specify that your aerial applicator use this proved Dow product.

Esteron 245 O.S., Radapon®, Kuron® and other Dow chemicals have become indispensible tools of modern forest management. They can double pine growth. They make harvesting easier. They keep roads, lanes and communication lines clear.

See why one forester with 125,000 acres under his care states: "Present operations could not be carried on without chemicals". Get your free copy of *More Timber . . . Faster* by writing to: THE DOW CHEMICAL COMPANY, Agricultural Chemical Sales Dept., Midland, Michigan.

YOU CAN DEPEND ON DOW

Council's Column

The Journal and The Membership

Probably most members of the Society will agree that one of our most important activities is the publication of our official periodical—the JOURNAL OF FORESTRY.

This enterprise accounts for the largest single item of expense in our budget, and I sense that there is good agreement that the money is well spent. It is difficult to imagine how the profession of forestry could have developed as well as it has in America without such a unifying medium for professional communication. The JOURNAL not only documents progress as it is made, but it supplies practicing foresters with current information of key importance in shaping the future of both forests and foresters. About two-thirds of the main articles in the JOURNAL report results of research related to forestry. This presumably reflects recognition of the fact that forestry practice in America has become a highly technical and complicated business, and that members of the profession must keep up with fast-moving trends if they are to serve their employers well. Annually supplying its subscribers with the results of experience and research having an estimated aggregate value thousands of times the subscription cost, the JOURNAL is rated a forester's best buy.

Good as it is, I find a prevailing conviction among our members that the JOURNAL could and should be better.

"Let's have more articles by the 'dirt' foresters on the firing line. We want to read about their everyday work, their problems, accomplishments, and their ideas on where we are going and should be going in forestry."

For years, many of us have expressed or agreed to the sentiments contained in this quotation. An examination of the 1957 JOURNAL shows that we did not make much progress on this objective last year. Not more than a few of the more than one-hundred main articles published in the JOURNAL could be classed as "dirt forester" productions. This is in spite of very considerable efforts on the part of the editorial staff, various members of the Council, and the President of the Society to stimulate and solicit such articles.

The editor's report in the January issue shows that what is published in the JOURNAL is determined largely by what is submitted for publication. Some 91 percent of the articles sent in were accepted. To quote the editor:

"This high proportion of final acceptances, even though considerable revision may be involved, indicates that the editorial board is not by the power of veto molding the contents of the JOURNAL."

More than 150 years ago, von Cotta recognized clearly one of the problems that still plagues us today:

"... the forester who practices much writes but little, and he who writes much practices but little."

Despite the fact that many of the foresters responsible for everyday progress in the woods have little time for the pen, the editorial staff and the Council plan to continue and to increase efforts to obtain more articles on current practical forestry applications for the JOURNAL. This problem deserves our concern. I expect the Sections, Chapters, and Groups will want to give it more attention, too. The production of at least one good prac-

SAFEST, SIMPLEST DRIP TORCH YOU CAN USE

FORESTER Seal-Tite Torch

Provided with fuel trap, check valve and flash-back screen to protect you from explosion hazards.

Welded tank with cushion base, double bottom, oil proof gaskets and tight valves SEALTITE against leakage.

No Pressure—No Preheating. Burns diesel oil, stove oil or mixed fuels with low flash-point.

Approved for use by U. S. Forest Service

Manufactured By

WESTERN FIRE EQUIPMENT CO.

69 Main St. San Francisco, California

"You can depend on Ben!"

More than a slogan—this saying has become the "buy-word" for thousands of Foresters who order their needs by mail.

My Catalog lists only *proven products* of manufacturers in U.S.A. and some foreign countries.

You get fast, intelligent service from Atlanta . . . and *you pay no more* when you order from Ben. I ship anywhere.

Anything and everything in . . .

FORESTRY Tools and Equipment

PERSONAL SERVICE PROMPT SHIPMENT! If it's not listed in my Catalog, I'll get it for you at no extra cost!

"You can depend on Ben."

THE Ben Meadows CO.

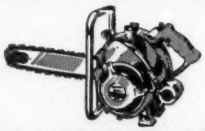
phone CEdar 3-2601

315 Pharr Road, N. E.

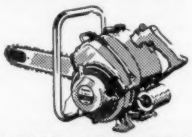
ATLANTA 5, GEORGIA

MORE CHAIN POWER

Now...get up to one extra horsepower for your money!



MORE CHAIN POWER IN 5-HP CLASS. New Golden "Logmaster" has Roller-Bearing nose, direct drive, 18", 24" and 30" bar sizes. Engine weight 22 lbs. Retail price from $285.00* complete.

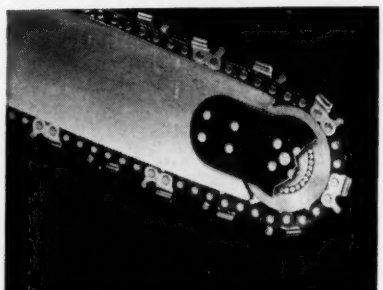


MORE CHAIN POWER IN 3-HP CLASS. New Silver "Logmaster" has Roller-Bearing nose, direct drive, 18", 24" and 30" bar sizes. Engine weight 21 lbs. Retail price from $229.00* complete.

Each Remington chain saw has the revolutionary Roller-Bearing nose that cuts wasteful friction . . . delivers up to 20% more usable chain power. That means up to one extra *horsepower* in the 5-hp Golden "Logmaster" and faster, easier cutting for you!

But a bonus of power is just one advantage. Remington chain saws are *dependable*, built for the most demanding service . . . with non-clogging air filter, positive rewind starter with nylon cord, thumb-button oiler, sturdy cast-aluminum housing and numerous other features.

Get acquainted with these powerful, direct-drive saws that offer fast, efficient cutting in any position...ask your dealer to demonstrate Remington chain saws. They're your best dollar value in saws today!



ORIGINAL ROLLER-BEARING NOSE revolves on precision-ground steel Roller Bearings. This means less friction, more power and longer wear for Remington chain saws.

**Specifications and recommended retail prices subject to change without notice. Canadian prices slightly higher.*

Remington **Mall**®

MALL TOOL COMPANY
Division of Remington Arms Company, Inc., Bridgeport, Conn.
In Canada: Mall Tool, Ltd., 36 Queen Elizabeth Blvd., Toronto, Ontario

SEND FOR FREE CATALOG which shows complete Remington line of Mall chain saws... gives specifications . . . describes saw best suited for your needs.

MALL TOOL COMPANY JF-3
Division of Remington Arms Company, Inc.
Bridgeport 2, Connecticut

Please send me without obligation new FREE catalog on Remington chain saws.

*Name*_____

*Address*_____

*City*_____ *Zone*____ *State*_____

tical forestry article for the JOURNAL annually might be a worthy project for each Section. If such a program gets rolling, we can have one or two outstanding "dirt forester" articles in every issue instead of just a few each year.

Foresters have an obligation to communicate for the benefit of their contemporaries and successors some of the fruits of their observations, discoveries, and experience. Every work day throughout the land, thousands of our members are developing more know-how and practicing more forestry than was dreamed possible only a decade ago. If ". . . he who practices much . . ." will now write just a little, the JOURNAL and the profession will be enriched thereby.

PHILIP A. BRIEGLEB

Society Membership Climbs

Society membership, as of December 31, 1957, was 11,602—a net increase of 490 over 1956. Number in the several grades is a follows:

Grade	*1956*	*1957*
Fellow	75	90
Member	4,524	5,393
Junior	4,484	3,917
Student	989	1,073
Affiliate	713	766
Associate	240	239
Corresponding	67	103
Honorary	20	21
Total	11,112	11,602

Five years ago 1953 total membership was 9,557.

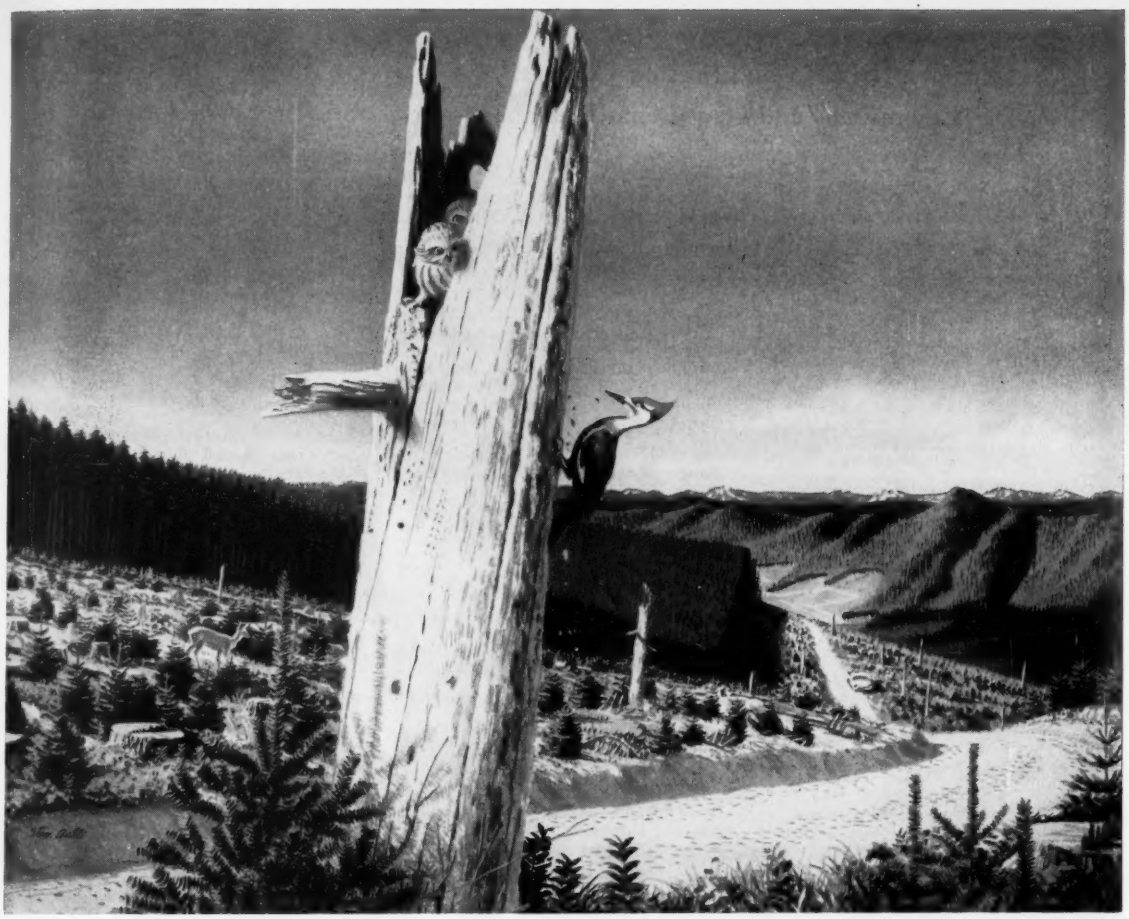
Total number of applications handled during 1957 was 2,650, including reinstatements, advancements, and initial grades. Interest in Student membership continues. When the grade was initiated in 1951 there were, at the end of that year, 550 Student Members; in 1957, 1,051—about a 100 percent increase. Of note, also, is the increase in the Member grade. In 1953 there were 4,416 Juniors and 3,687 Members. Now, in 1957, Juniors number 3,917 and Members 5,393. Most of the increase in the Member grade is due to the voluntary application of Juniors for "regular" advancement, indicating their willingness to assume the responsibilities and increased dues of the higher grade.

Increased activity, not only in membership but in other Society projects, is reflected in net earnings for 1957 of $9,740—the largest in the Society's history.

Special Coverage Planned

Plans are underway for special coverage in the JOURNAL during 1958 of three subjects of considerable interest to professional foresters. Tentatively scheduled for August, a special issue is in the making that will survey new developments in the field of wood utilization and research efforts in that field. A second special issue to bring readers up to date on developments in forest tree improvement and genetics is planned with a selection of articles scheduled for November publication. In addition to these two special issues, preliminary steps have been taken to secure a round up of articles from competent authorities on the subject of known environmental effects resulting from the use of herbicides.

Now!
THE WOODLOT CONSERVATION TOOL YOU'VE BEEN WAITING FOR...IT'S THE NEW
BRADY
Manually Operated
TREE GIRDLER!*
FAST! SAFE! SURE!
The BRADY TREE GIRDLER weighs less than 2½ pounds. It is simple to use. It is positively safe. It is a precision-made chain tool that will effectively girdle a 4-inch tree in less than 20 seconds! The girdles it makes will slowly kill any cull or unwanted hardwood tree, and keeps sprouting to the absolute minimum! It is the finest forestry tool ever developed for both large and small woodland owners.
Mail This Coupon Today!
JOE H. BRADY AND ASSOCIATES
Dept. JF, 3rd Ave. So. At 31st St. • Birmingham, Ala.
Gentlemen: Will you please ship immediately,_____BRADY TREE GIRDLERS at your introductory offer of $29.95 each, including shipping charges. Attached is my _____check _____money order.
NAME_____
ADDRESS_____
CITY_____STATE_____
(Note: 10% discount on orders of 6 or more.)
$29.95
Including Shipping Charges
JOE H. BRADY AND ASSOCIATES
*Patent Pending



forest products for tomorrow are growing on tree farms today...

Quality homes of wood are still America's best building buy. Many of the finest are built of beautiful west coast lumber sold under Weyerhaeuser's 4-Square trademark.

All across America, tree farm lands that were harvested to provide wood for past and present generations are green with growing trees. Rooted in rich forest soil amid the stumps of their elders, these new timber crops will supply an abundance of useful forest products to meet *future* needs. This pattern of harvesting and restocking can go on indefinitely through proper management of commercial timberlands.

Forestry techniques used on Weyerhaeuser tree farms, for example, are intended to maintain a perpetual balance in the cycle of tree growth and harvest. By measuring the amount of new wood being grown on company lands, our foresters are able to establish the volume of merchantable timber to be cut. After each harvest, the land is put back into production through planned reforestation programs. These practices, together with constant protection against fire, insects and disease will enable our timberlands to produce a continuous flow of wood...*forever.*

The prophecy of a steady rise in the future demand for wood emphasizes the importance of good forestry today. *Write us at Box A, Tacoma, Wash., for a free booklet on industrial forestry,* ***Promise of the Trees.***

Weyerhaeuser Timber Company

making forestlands serve America better by scientific management

Society Division and Section Officers, Committees and Representatives

Division Officers 1958

Division of Education

A. Bigler Crow, chairman; School of Forestry, Louisiana State University, Baton Rouge, La.

Peter W. Fletcher, vice chairman; School of Forestry, University of Missouri, Columbia, Mo.

William C. Bramble, secretary; School of Forestry, Pennsylvania State University, University Park, Pa.

Division of Economics and Policy

S. Blair Hutchison, chairman; Intermountain Forest and Range Experiment Station, Ogden, Utah.

John A. Zivnuska, vice chairman; 243 Walter Mulford Hall, University of California, Berkeley 4, Calif.

Robert Keniston, secretary; 50 West Cherry St., Woodmont, Conn.

Division of Forest Management

Walter F. McCulloch, chairman; School of Forestry, Oregon State College, Corvallis, Ore.

Russell K. LeBarron, vice chairman; California Forest and Range Experiment Station, Berkeley, Calif.

Raymond R. Moore, secretary; Utah State University, Logan, Utah

Division of Forest Products

Harry E. Troxell, chairman; School of Forestry and Range Management, Colorado State University, Fort Collins, Colo.

Bernard M. Granum, vice chairman; Iron Range Resources and Rehabilitation, Court House, Hibbing, Minn.

Rudolph Grah, secretary; School of Forestry, University of California, Berkeley 4, Calif.

Division of Forest Recreation

F. C. Koziol, chairman; U. S. Forest Service, Salt Lake City, Utah.

F. W. Childs, vice chairman; National Park Service, Omaha, Nebr.

William A. Parr, secretary; Maryland Department of Forests and Parks, Annapolis, Md.

Division of Forest-Wildlife Management

William L. Webb, chairman; State University of New York, College of Forestry, Syracuse 10, N. Y.

Elbert H. Reid, vice chairman; Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo.

Odell Julander, secretary; Intermountain Forest and Range Experiment Station, Ogden, Utah.

Division of Range Management

Elbert H. Reid, chairman; 624 Shields, Fort Collins, Colo.

Grant A. Harris, vice chairman; Dept. of Forestry and Range Management, Washington State College, Pullman, Wash.

Joe A. Wagner, secretary; 1504 Timber Lane, Falls Church, Va.

Division of Silviculture

James D. Curtis, chairman; Intermountain Forest and Range Experiment Station, Ogden, Utah.

William H. Cummings, vice chairman; Forest Research Center, Weyerhaeuser Timber Co., Centralia, Wash.

Richard D. Rosenberg, secretary; Diamond Match Co., Chico, Calif.

FREE CATALOG for the PROFESSIONAL FORESTER

A new dimension in forestry service . . .

96 PAGES FULLY ILLUSTRATED

Write today, for your free copy of Catalog No. 3. We ship within 24 hours of receipt of order—your money cheerfully refunded if not satisfied.

NASCO Fort Atkinson, Wisconsin
"Supplies and Equipment for the Professional"

20 MILLION TREES A YEAR

Seedlings for Christmas Tree and Forest Tree plantings. *Transplants* for Conservationists, Timber Operators and Farmers.

All Musser stock is from selected seed with good heredity characteristics. Our tremendous volume means wide selection at a *price saving* to you. For example:—

NORWAY SPRUCE—*fast growing*, 2-yr., S., 5 to 10", per 1,000, $35.00.

SEE THE DIFFERENCE

★*Heavy Roots and Sturdy Tops of Musser Seedlings compared with ordinary seedlings.*

Write for Free Catalog with wholesale planting list. Ask for Free Christmas Tree Growers' Guide.

MUSSER FORESTS, INC. 26-C INDIANA, PA.

FORESTRY TERMINOLOGY

A glossary of technical terms used in forestry

NEW — REVISED — ENLARGED — 1958 EDITION

Included are definitions of all terms that the practicing forester uses in his daily work and encounters in forestry literature.

A MUST for every forester's desk or library
Price, postpaid $3.50

Order from
SOCIETY OF AMERICAN FORESTERS
Mills Building, Washington 6, D. C.

PROCEEDINGS

(1957)

Syracuse, N. Y. Meeting

A special volume containing all Division and General Session papers presented at the Society's Annual Meeting held in Syracuse, N. Y., November 10-13, 1957.

Theme: "Forest Land Use in Transition."
Postpaid $5 per copy

Send order with check.
SOCIETY OF AMERICAN FORESTERS
Mills Building, Washington 6, D. C.

Division of Watershed Management

Peter W. Fletcher, chairman; School of Forestry, University of Missouri, Columbia, Mo.

Sidney Weitzman, vice chairman; Lake States Forest Experiment Station, St. Paul Campus, University of Minnesota, St. Paul 1, Minn.

Jack S. Rothacher, secretary; U. S. Forest Service, Blue River, Ore.

Section Officers

(As of February 1, 1958, Dates terms began are given.)

Allegheny Section

2-16-58

W. W. Ward, Chairman
Pennsylvania State Forest School, Mont Alto, Pa.
William A. Parr, Vice Chairman
State Office Bldg., Annapolis, Md.
Paul Felton, Secretary-Treasurer
R.D. #1, Norristown, Pa.
William A. Parr, Membership Chairman
State Office Bldg., Annapolis, Md.
Chapters: 1. New Jersey
2. Philadelphia
3. West Virginia

Appalachian Section

1-1-58

H. F. Lathrop, Chairman
Lightsey Brothers, Miley, S. C.
Ellwood S. Harrar, Vice Chairman
School of Forestry, Duke University, Durham, N. C.
W. T. Ahearn, Secretary-Treasurer
Box 357, Columbia, S. C.
Ellwood S. Harrar, Membership Chairman
School of Forestry, Duke University, Durham, N. C.
Chapters: 1. Edisto
2. Southeastern Virginia
3. Winyah

Central Rocky Mountain Section

7-1-57

E. H. Mason, Chairman
1204 S. Grand St., Glenwood Springs, Colo.
E. W. Mogren, Vice Chairman
College of Forestry and Range Management, Colorado State University, Fort Collins, Colo.
Fred B. Knight, Secretary-Treasurer
Forest Insect and Disease Lab., South Hall, Colorado State University, Fort Collins, Colo.
Harry E. Troxell, Jr., Membership Chairman
624 Armstrong Ave., Fort Collins, Colo.
Chapters: None

Central States Section

10-3-57

C. I. Miller, Chairman
Dept. Forestry and Conservation, Purdue University, Lafayette, Ind.
Robert R. Paton, Vice Chairman
1947 Snouffer Road, R.R. #2, Worthington, Ohio
J. C. Callahan, Secretary-Treasurer
Department of Forestry, Purdue University, West Lafayette, Ind.
Robert R. Paton, Membership Chairman
1947 Snouffer Road, R.R. #2, Worthington, Ohio
Chapters: 1. Illinois Technical Forestry Association
2. Indiana
3. Ohio

Columbia River Section

7-1-57

Robert D. Hostetter, Chairman
1420 Olive Street, Salem, Ore.
Martin Syverson, Vice Chairman
1101 W. 48th St., Vancouver, Wash.
John Bell, Secretary
State Forestry Dept., 2600 State St., Salem, Ore.
Clyde H. Stratton, Treasurer
539 N.W. 10th Ave., Portland 9, Ore.
Robert Mason, Membership Chairman
754 East Judson, Salem, Ore.
Chapters: 1. Blue Mountain
2. Capitol
3. Central Oregon
4. Coos Bay
5. Hawaii
6. Longview
7. Portland
8. Salem
9. Shasta-Cascade
10. Siskiyou
11. Tillamook-Clatsop
12. Umpqua
13. Willamette

Gulf States Section

7-1-57

James W. Craig, Chairman
Leavell Woods Rural Station, Jackson, Miss.
Jack S. Cooper, Vice Chairman
2932 36th St., Meridian, Miss.
Ralph R. Robertson, Secretary-Treasurer
Box 534, State College, Miss.
Jack S. Cooper, Membership Chairman
2932 36th St., Meridian, Miss.
Chapters: None

Inland Empire Section

7-1-57

Richard W. Dingle, Chairman
Dept. of Forestry, Washington State College, Pullman, Wash.
Dale L. Arnold, Vice Chairman
U. S. Forest Service, Princeton, Idaho
Grant A. Harris, Secretary-Treasurer
Dept. of Forestry, Washington State College, Pullman, Wash.
Robert R. Seale, Membership Chairman
College of Forestry, University of Idaho, Moscow, Idaho
Chapters: None

Intermountain Section

3-10-56

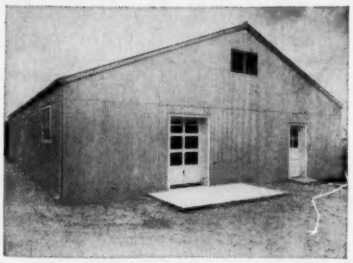
George V. Hjort, Chairman
801 North 17th St., Boise, Idaho
Steele Barnett, Secretary-Treasurer
Boise Cascade Corp., Box 200, Boise, Idaho
Fred R. Mason, Membership Chairman
2539 Jefferson Avenue Ogden, Utah
Chapters: 1. Southwestern Idaho

Kentucky-Tennessee Section

12-57

Russell Stadelman, Chairman
Nickey Bros., Inc., 2700 Summer Avenue, Memphis 12, Tenn.
James A. Newman, Secretary-Treasurer
Dept. of Horticulture, University of Kentucky, Lexington, Ky.
Chapters: None

Pole-type construction goes up fast.. saves building costs



Eight men erected this 40 ft. x 80 ft. pole-type factory building in two weeks for the Andover Corporation of Lafayette, Indiana. Secret of the speedy erection and low cost was pressure-treated building poles. Poles, set in the ground, provide sturdy truss roof supports for a clear, wall-to-wall use of interior space. Building is insulated, heated and air conditioned.

Pole-type buildings are ideal for many commercial and industrial buildings of all types. Buyers report savings up to 50% over conventional structures . . . no excavating, no forms, no foundation is needed. Finished buildings are permanent – protected against decay and termites. Equally important, they are easy to maintain and can be simply modified or expanded.

Full details on economical pole-type construction and its inherent advantages are yours without obligation.

KOPPERS
KOPPERS PRESSURE-TREATED WOOD

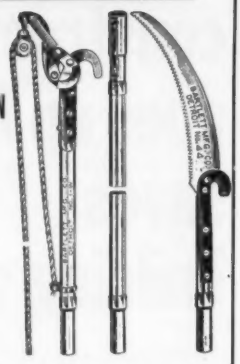
Wood Preserving Division G-15
Koppers Company, Inc.
772 Koppers Building
Pittsburgh 22, Pa.

Please send me the folder "Basic Suggestions for Designing and Erecting Pole-Type Buildings."

Name_____
Position_____
Firm_____
Address_____
City, State_____

UNSURPASSED

"WE" COMBINATION PRUNER and POLE SAW



Used by experts. Heavy-duty 30" Pruner (1¼" capacity) with compound lever action head for fast, easy cutting. Side-cutting head leaves clean wounds. PLUS fast-cutting, 16" curved blade Pole Saw. Octagon spruce poles fit both heads. Two sections, intermediate and bottom, furnished. With 4' sections, $28.30; 6', $32.70; 8', $34.60 delivered in U.S.A.

Write today for new catalog showing complete line of Bartlett tree surgery tools and supplies.

BARTLETT MFG. CO.

3015 E. Grand Blvd. Detroit 2, Mich.

New England Section
3-9-56

G. S. Wheeler, Chairman
U. S. Forest Service, Laconia, N. H.
David M. Smith, Vice Chairman
School of Forestry, Yale University, New Haven, Conn.
Fred Holt, Secretary-Treasurer
Maine Forest Service, Augusta, Maine
David M. Smith, Membership Chairman
School of Forestry, Yale University, New Haven, Conn.
Chapters: 1. Granite State
2. Vermont

New York Section
1-31-57

Ralph G. Unger, Chairman
109 Ramsey Avenue, Syracuse 3, N. Y.
Stanley W. Hamilton, Vice Chairman
89 Ludlow St., Saratoga Springs, N. Y.
Shelley W. Potter, Jr., Secretary-Treasurer
5559 S. Salina St., Syracuse, N. Y.
C. C. Larson, Membership Chairman
State University of New York, College of Forestry, Syracuse, N. Y.
Chapters: 1. Adirondack
2. Black River Valley
3. Capital District
4. Iroquois
5. Longhouse
6. Metropolitan
7. Mid-Hudson
8. Upper Hudson

Northern California Section
6-1-57

Myron S. Wall, Chairman
5524 Elvas Ave., Sacramento, Calif.
Harry Abraham, Vice Chairman
245 E. Rose, Sonora, Calif.
Ezra M. Hornibrook, Treasurer
737 Spruce St., Berkeley 7, Calif.
Wayne G. Hubbard, Secretary
1903 Capitol Ave., Sacramento, Calif.
Jack Cameron, Membership Chairman
Land Dept., Pacific Gas & Electric Co., 245 Market St., San Francisco, Calif.
Chapters: 1. Bay Area
2. Eldorado-Amador
3. Feather River
4. Lassen-Almanor Forum
5. North Coast Forest Forum
6. Redding
7. Sacramento

Northern Rocky Mountain Section
6-8-57

Victor O. Sandberg, Chairman
U. S. Forest Service, Missoula, Mont.
Donald D. Baldwin, Vice Chairman
542 Eddy Ave., Missoula, Mont.
John H. Dieterich, Secretary-Treasurer
1949 Wylie, Missoula, Mont.
Donald D. Baldwin, Membership Chairman
School of Forestry, Montana State University, Missoula, Mont.
Chapters: 1. Libby

Ozark Section
7-1-57

Nelson F. Rogers, Chairman
900 East 1st, Salem, Mo.
M. G. Hoyer, Vice Chairman
Forestry Div., Missouri Cons. Com., Jefferson City, Mo.
R. C. Smith, Secretary-Treasurer
School of Forestry, University of Missouri, Columbia, Mo.
M. G. Hoyer, Membership Chairman
Forestry Div., Missouri Cons. Com., Jefferson City, Mo.
Chapters: None

Puget Sound Section
7-1-57

Don L. Fraser, Chairman
Rt. 6, Box 333, Olympia, Wash.
George R. Staebler, Vice Chairman
Weyerhaeuser Timber Co.
P.O. Box 420, Centralia, Wash.
James E. Sheppard, Secretary-Treasurer
7901 Leschi Rd., Tacoma 99, Wash.
George R. Staebler, Membership Chairman
Weyerhaeuser Timber Co., P.O. Box 420, Centralia, Wash.
Chapters: 1. Alaska
2. Central-Washington
3. Mid-Columbia
4. North Olympic
5. North Puget Sound
6. Southwest Washington

Southeastern Section
1-30-58

Henry A. Wilson, Chairman
Alger-Sullivan Sawmill Co., Century, Fla.
Leon A. Hargreaves, Jr., Vice Chairman
P. O. Box 1183, Macon, Ga.

a Stratex "spec" for scientists!

WHY NOT FACILITATE FIELD WORK WITH
SILVER CITY HAND LEVELS?

Instantly adjust, just rotate index prism from outside, even with gloves! Lazy bubble, jet-corundum finish on featherweight aluminum, non-metallic sight tube bearing, combine to bring you world's best engineered Locke-type hand level. A must for field engineers! $12 in USA and Canada

WASATCH LAYOUT PENTAPRISM
EASES LAYOUT JOBS

Slash time and costs locating photo check points, grid stations, any mensuration chore involving right angles. Optical square aims like a pistol—gives beautiful, POSITIVE foresight image. Aluminum housing, jet-corundum finish, 2½ ounces weight. Saddle leather belt case.

$25 in USA and Can

FACTORY SHIPMENTS IF YOUR DEALERS OUT OF STOCK dept. J

STRATEX INSTRUMENT CO.
3515 SUNSET BLVD. LOS ANGELES 26, U.S.A.

Harry M. Roller, Jr., Secretary-Treasurer
Woodlands Dept., International Paper Co., Mobile, Ala.
Leon A. Hargreaves, Jr., Membership Chairman P. O. Box 1183, Macon, Ga.
Chapters: 1. Alabama
2. Florida
3. Georgia

Southern California Section
7-25-56

David H. Rogers, Chairman
914 W. Highland Ave., Redlands, Calif.
Oliver Holmes, Vice Chairman
U. S. Forest Service, Mentone, Calif.
Lynn R. Biddison, Secretary-Treasurer
Lytle Creek, Star Rt. Box 100, Fontana, Calif.
Oliver Holmes, Membership Chairman
U. S. Forest Service, Mentone, Calif.
Chapters: None

Southwestern Section
7-1-57

Albert C. Hunt, Vice Chairman
% Southwest Lumber Mills, Flagstaff, Ariz.
Chandler P. St. John, Secretary-Treasurer
% U. S. Forest Service, Springerville, Ariz.
Edgar H. Palpant, Membership Chairman
Rocky Mt. Forest Experiment Station, Building T-10, Univ. of New Mexico, Albuquerque, New Mex.
Chapters: None

A major step forward in forest site preparation

Efficiency of different methods and machines compared in thorough on-the-job tests near Brunswick, Ga.

Last year, in close co-operation with the Brunswick Pulp & Paper Co., Caterpillar Tractor Co. conducted a comprehensive three months' study of different forest site preparation methods near Brunswick, Ga. Some 700 acres in three areas were cleared and planted in trees. Six rugged track-type Caterpillar Diesel machines, ranging in horsepower from 63 to 320 HP, were used. Attachments included Rome offset disc harrows, Fleco rakes, Hyster winches, an anchor-type chain and stumpers and cab guards. Each machine and attachment worked the length of time needed to provide a "dollars and cents" yardstick of production results. Some operational pictures are shown here. The results have been compiled on the following subjects: Stump Treatment; Stump Clearing and Tree Cutting; Chaining; Raking and Windrowing; Harrowing. For information, contact your nearby Caterpillar Dealer who can provide further assistance on this subject.

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

Caterpillar, Cat and Traxcavator are Registered Trademarks of Caterpillar Tractor Co.

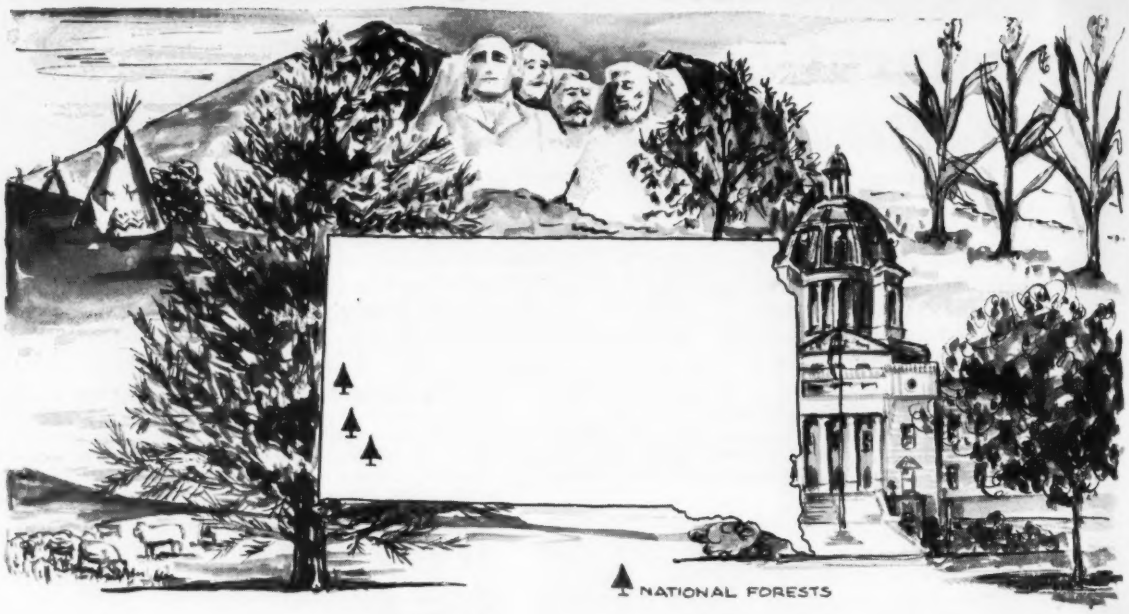
Before: One of three areas selected for the project. In general, ground conditions ranged from sandy to marshy. In one area, pine and palmetto were predominant; in another, hammock land with mixed pine and hardwoods; and in the third, upland hardwood, mixed pine, palmetto and brush. Despite some rain, tractor footing in general was good.

Shearing and Stumping: A CAT D8 Tractor with a Rome K-G blade at work in dry sandy soil, cleared except for standing live oaks ranging in diameter from 18" to 81". The remaining trees were hit by the stinger at a height of 3' to 4' above ground level, sliced and pushed over. Stumps were then sheared at ground level by the stinger and cutting edge in one or several passes.

Raked and Windrowed: Typical area after raking and windrowing. Machines used: Caterpillar D9, D8 and D7 Tractors and No. 977 Traxcavator with rakes. The more dense areas were cleared by the D9, the less dense by the other machines. Cover consisted of live oak and mixed hardwood with an understory of palmetto, gallberry, myrtle and vines.

Harrowing: A D8 with heavy-duty offset harrow on the job after an area of upland hardwood, mixed pine and heavy brush had been chained, raked and stumps cut at ground level. The number of passes — one or two — on an operation like this is up to the individual forest owner. After preparation, areas were planted by a D4 and tree planter.

No. 39 of a series featuring forestry practices, projects and products.



South Dakota

111 Tree Farms on 26,000 Acres

Forest history has been made in South Dakota. The first federal forest reserve in the United States, created under an act of Congress of March, 1891, was set aside in the Black Hills by President Cleveland in 1897. The first sale of timber from a national forest was made on the Black Hills Reserve, and it appears on the records of the U. S. Forest Service as Case I. Cutting operations in connection with that sale were the first to be made in this country under carefully planned and supervised conditions designed to assure future timber crops. These same cutting operations marked the beginning of cooperative efforts by industry and government to establish good forestry practices on the commercial forest lands of the country.

South Dakota has a forest area of 2,169,000 acres . . . about 4.4 per cent of the state's total land. Much of this land is used not only for timber management, but also for hunting, fishing, hiking and other recreation. Nearly three million tourists visited the Black Hills in 1957.

The native hardwood forests are well scattered throughout the state. Fringes of cottonwood or the smaller hardwoods are found along all streams. The valley of the Missouri River is especially noted for its large groves of hardwood trees. Hardwoods are also found growing in nearly all steep gulches and ravines, and most lakes are bordered by them.

As early as 1873, the planting of trees was set by law as a condition of acquisition of title to homestead land in the territory that is now South Dakota. The impetus given to tree planting by these early laws, coupled with a love of trees and the need for protection for farmsteads and crops from wind, has resulted in many acres of woodland on the once treeless plains.

Windbreak and shelter belt plantations, established for most part by farmers and ranchers, are found chiefly east of the Missouri River. Last year, South Dakota lead all other states in acreage planted to windbreaks and shelterbreaks on private land.

The Department of Game, Fish and Parks owns a conifer nursery which is located at Watertown. Deciduous seedlings are provided chiefly by South Dakota's commercial nurseries. The tree planting trend on private land is on the upsurge in South Dakota, with over four million trees going into the ground during the 1957 season.

DIVISION OF FORESTRY AND PARKS—*contribution to this series does not necessarily constitute endorsement of* SOUTHERN GLO *products.*

SOUTHERN GLO is a natural for insect control, growth studies, cutting and other marking operations requiring speed, ease and low cost. Available in 7 highly visible colors, in paste for easy mixing to spray consistency, and in ready-mixed form, ready to use as it comes from the can. Newest development is the Southern Glo quart package designed to attach on the Nelson spray gun.

SOUTHERN COATINGS AND CHEMICAL CO. Dept. 2, Sumter, South Carolina—New Orleans, La.

Upper-Mississippi Valley Section
7-1-57

Earl J. Adams, Chairman
4705 Tenth Ave., South Minneapolis, Minn.

Emil Kukachka, Vice Chairman
908 St. Paul Ave., St. Paul 5, Minn.

Bernard Granum, Secretary-Treasurer
c/o Minnesota Office of Iron Range Resources and Rehabilitation, Court House, Hibbing, Minn.

John W. Hubbard, Membership Chairman
Box 325, Big Falls, Minn.

Chapters: 1. Iowa
2. Lake Superior
3. North Dakota
4. Northwest Minnesota
5. Southern Minnesota

Washington Section
7-1-57

C. B. Webster, Chairman
110 N. French St., Alexandria, Va.

Everett H. Clocker, Vice Chairman
Forest Service, U. S. Dept. of Agriculture, Washington 25, D. C.

Charles H. Stoddard, Secretary-Treasurer
% Resources for the Future, 1145 19th St., N.W., Washington 6, D. C.

Henry F. Wersching, Membership Chairman
515 Bellview Drive, Falls Church, Va.

Chapters: None

Wisconsin-Michigan Section
7-1-57

John Macon, Chairman
Consolidated Water Power & Paper Pulp Co., Rhinelander, Wis.

Donald G. Zettle, Vice Chairman
Dept. of Conservation, Marquette, Mich.

Donald Prielipp, Secretary-Treasurer
724 Hamilton Ave., Kingsford, Mich.

Donald G. Zettle, Membership Chairman
Dept. of Conservation, Marquette, Mich.

Chapters: 1. Hiawatha
2. Lower Michigan
3. Madison
4. Milwaukee
5. Northeastern Wisconsin

Society Committees and Representatives

1958

Joint Committee on Fire Control Equipment with American Society of Mechanical Engineers

A. A. Brown, chairman; U. S. Forest Service, Washington 25, D. C.

W. E. McCraw

Gilbert I. Stewart

Council Committee on Memorial Award

P. A. Briegleb, chairman; Southern Forest Expt. Sta., 704 Lowich Bldg., 2026 St. Charles Ave., New Orleans 13, La.

K. P. Davis

M. K. Goddard

Representative to the National Research Council Division of Biology and Agriculture

Harold G. Wilm, College of Forestry, State University of New York, Syracuse 10, N. Y.

Representatives to the Council of the American Association for the Advancement of Science (Section O), Agriculture

Paul M. Dunn, St. Regis Paper Company, 150 East 42nd Street, New York 17, N. Y.

W. G. McGinnies, Central States Forest Experiment Station, Old Federal Building, Columbus 15, Ohio

Representative to Forest History Foundation

Frank H. Kaufert, School of Forestry, University of Minnesota, St. Paul 1, Minn.

Representative to Natural Resources Council of America

Henry Clepper

Selected RONALD Books

THE PHYSIOLOGY OF FOREST TREES

Edited by **Kenneth V. Thimann,** *with 33 Contributors.* **Ready March 31.** A new, authoritative contribution to biological science resulting from the First International Symposium on Forest Tree Physiology. Presents research work in nine areas of investigation on the forest tree. Topics include the ascent of sap, aspects of translocation, photosynthesis, mineral nutrition, biochemistry of bark and wood, growth of roots and shoots, and photoperiodic response. *267 ills., tables; 607 pp.* $12.00

Forest Soils—*Their Properties and Relation to Silviculture*

S. A. Wilde. New guide interprets the relationships between good forest management and soil properties. Correlates physics, chemistry, and biology of soils with features of forest stands — composition, rate of growth, quality of products. Gives a working knowledge of soils needed for growing nursery stock, tree planting, silvicultural cuttings, etc. *216 ills., tables; 537 pp.* $8.50

A World Geography of Forest Resources

Stephen Haden-Guest, John K. Wright, *and* **Eileen M. Teclaff,** *with 34 Contributors.* A world-wide appraisal of forest resources. Considers forest's relation to rainfall, typography, soils, etc., and discusses forest yields in the face of ever-changing demands. *Edited for the American Geographical Society. 35 maps, 219 ills., tables; 790 pp.* $12.50

THE LAW OF WATER ALLOCATION *In the Eastern United States*

Edited by **David Haber, Stephen W. Bergen,** *12 Contributors and 52 discussion participants, observers.* **Just out!** The problem of increasing conflicts of interest over water rights in the eastern U. S. New book analyzes the water laws of three eastern states and reviews the water law experience of western states. Discusses the constitutionality of recent legislative proposals; examines legislative alternatives and the need for further research. *Edited for The Conservation Foundation. 666 pp. Paper cover.* $7.50

Conservation Law and Administration

William F. Schulz, Jr. A comprehensive analysis of a state's conservation laws and the administration of its renewable resources. A Model Conservation Administration Act provides a blueprint for legislative action in any state. A digest of Pennsylvania's laws plus pertinent federal statutes are included as well as a commentary on their scope and adequacy. *Sponsored by The Conservation Foundation. 34 ills., tables; 607 pp.* $10.00

—USE COUPON TO ORDER—

The Ronald Press Company
15 East 26th St., New York 10

Please send me books checked below:

- ☐ The Physiology of Forest Trees, *Thimann* $12.00
- ☐ Forest Soils, *Wilde* 8.50
- ☐ A World Geography of Forest Resources, *Haden-Guest, et al* 12.50
- ☐ The Law of Water Allocation, *Haber and Bergen* 7.50
- ☐ Conservation Law and Administration, *Schulz* 10.00
- ☐ Bill me ☐ Check herewith

We pay postage if check accompanies order.

Name .....
Address .....
City ..... Zone ... State JF-1

THE RONALD PRESS COMPANY
15 East 26th Street, New York 10, N. Y.

Representative to American Institute of Biological Sciences

Henry Clepper

Committee for the Advancement of Forestry Education

Harold G. Wilm, chairman; College of Forestry, State University of New York, Syracuse 10, N. Y.
George B. Hartman
C. M. Kaufman
W. F. McCulloch
Ernest Wohletz

Committee for the Study of Education

Henry J. Vaux, chairman; School of Forestry, University of California, Berkeley 4, California
Richard E. McArdle
Bernard O. Orell
Hardy L. Shirley
Henry Clepper, Secretary
George A. Garratt, *ex officio*

Committee on Ethics

Henry J. Malsberger, chairman; 900 Peachtree Street, Atlanta 9, Ga.
Julius Kahn
A. D. Nutting
Archie E. Patterson
Howard A. Post

Committee on History of Forestry

E. N. Munns, chairman; 1639 Garnet Lane, Concord, Calif.
E. H. Frothingham
W. L. Hall
Ralph S. Hosmer
William D. Miller
Roland Rotty
R. K. Winters

Committee on International Relations

V. L. Harper, chairman; Forest Service, U. S. Department of Agriculture, Washington 25, D. C.
Paul W. Bedard
Col. H. B. Donaldson
George L. Drake
Paul M. Dunn
I. T. Haig
Jay H. Hardee
Hardy L. Shirley
Stephen H. Spurr
Russell Stadelman

Committee on Library of Congress Photograph Collection

Helmuth Bay, chairman; Rand McNally & Company, National Press Building, Washington 4, D. C.

Committee on Tree Nomenclature

W. A. Dayton, chairman; Forest Service, U. S. Department of Agriculture, Washington 25, D. C.
Henry I. Baldwin
Keith W. Dorman
John W. Duffield
Phillip J. Haddock
Elbert L. Little

Committee for 1958 Meeting

Reed W. Bailey, general chairman; Intermountain Forest and Range Experiment Station, Ogden, Utah.
Floyd Iverson, co-chairman; U. S. Forest Service, Ogden, Utah.

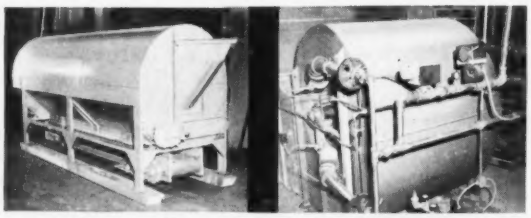
Program

Lewis M. Turner, chairman; College of Forest, Range and Wildlife Management, Utah State University, Logan, Utah.

Arrangements

Felix C. Koziol, chairman; U. S. Forest Service, Federal Building, Salt Lake City, Utah.

TREE SEED DRYING AND PROCESSING EQUIPMENT



SEED TUMBLER SEED DRIER

We Manufacture a Complete Line of

- TREE SEED DRIERS
- TUMBLERS
- HAMMER MILLS
- CLEANERS
- CONVEYORS
- BLOWERS
- DEWINGERS
- ELEVATORS
- WEIGHING EQUIPMENT

Our Engineering Services are available for single units or complete plant mechanization. Write today for full information.

Finco, inc.
AURORA 7, ILLINOIS

SANDVIK No. 1 BUSH AXE

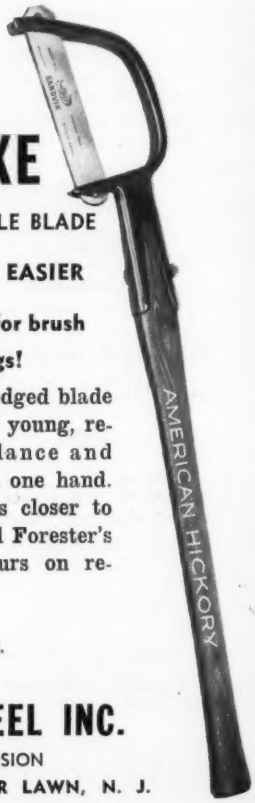
WITH REPLACEABLE BLADE

SAFER, FASTER, EASIER

. . . than an Axe for brush and saplings!

The thin, flat, keen-edged blade slices easily through young, resilient stems. Balance and weight for use with one hand. Protected blade cuts closer to ground. Circular and Forester's Tool Catalog is yours on request.

Write Dept. J.



Sandvik STEEL INC.
SAW & TOOL DIVISION
1702 NEVINS ROAD, FAIR LAWN, N. J.

Collating Committee on Grade Standardization of Forest Planting Stock

J. H. Stoeckeler, chairman; Lake States Forest Experiment Station, Rhinelander, Wis.

Council Committee on Membership

Henry J. Vaux, chairman; School of Forestry, University of California. Berkely 4, Calif.

B. E. Allen

W. D. Hagenstein

Committee on Forestry Career Counselling

T. D. Stevens, chairman; Department of Forestry, Michigan State College, East Lansing, Mich.

Wilbur B. DeVall

G. D. Marckworth

Lewis M. Turner

R. H. Westveld

Committee on Civil Service

R. J. Preston, chairman; School of Forestry, North Carolina State College, Raleigh, N. C.

F. H. Raymond

L. M. Turner

Albert C. Worrell

John A. Zivnuska

Coming Events

Wisconsin-Michigan Section

The winter meeting will be held March 14-15 in Milwaukee, Wis. (place not yet announced). Theme: "Using Public Relations to Promote Forestry." Total emphasis will be on forestry, not forestry *organizations.*

New York Section

The annual winter meeting of the New York Section will be held March 27-28 in Brubacher Hall, State Teachers College, Albany, N. Y. The meeting theme will be: "Understanding the Forest Preserve."

Southern Forestry Conference

Forest Farmers Association will sponsor the Southern Forestry Conference March 27-28 in the Virginia Hotel, Monroe, La.

Columbia River Section

The Columbia River Section will hold its spring meeting in Bend, Ore., April 18-19, with headquarters at the Pilot Butte Inn. Theme: "Intensification in Natural Resource Management Practices."

Society of American Foresters

The Hotel Utah, Salt Lake City, will be headquarters for the Society's 58th annual meeting scheduled for September 28-October 1.

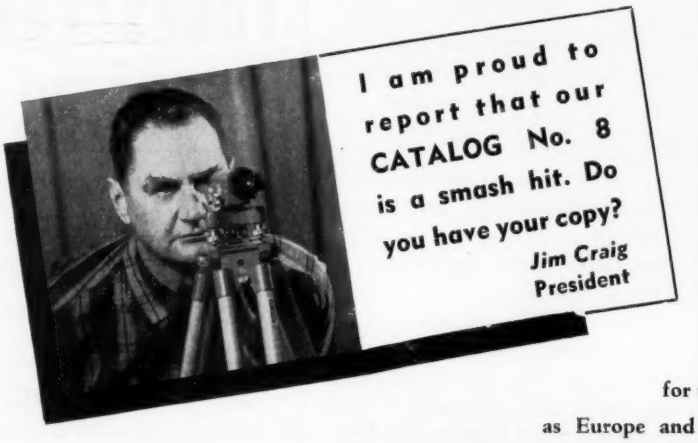
Necrology, 1957

Honorary

Pack, Randolph G., Darien, Conn.

Member

Adams, Bristow, Ithaca, N. Y.
Agee, Fred B., Chih, Mexico
Baudendistel, Martin E., Portland, Ore.
Beard, Ben, Doyle, Calif.
Beede, V. A., State College, Pa.
Buck, C. J., Portland, Ore.
Bull, Henry, New Orleans, La.
Cleator, Fred W., Seattle, Wash.
Cramer, Arthur, Missoula, Mont.
Cummings, Lyle A., Portland, Ore.
Ferguson, R. T., Phoenix, Ariz.
Fuller, Robert L., Oswego, Ore.
Godden, F. W., Ogden, Utah



You have to thumb through the 168 pages of this new catalog to appreciate its appeal, its practical value to men of the woods. In the broad field of forestry supply and equipment it stands alone—there has never been anything like it. It is, in every respect, a show window for the best tools this country as well as Europe and Asia have fashioned for the forester—tools as modern as the age we live in. Enjoy a new experience in forestry supply! Send today for your copy of Catalog No. 8

You will always find what you need when you need it at

FORESTRY SUPPLIERS, INC.

P. O. Box 8305—Battlefield Station, Jackson 4, Miss. • Telephone 4-3565

Eldon H. Myrick (1890-1957)

Eldon H. Myrick of Missoula, Mont. was killed in an automobile accident in southern Idaho early in November 1957. He was 67.

The retired Forest Service employee and his wife were enroute to their winter home in Phoenix, Ariz. at the time of the accident.

Mr. Myrick studied forestry at the University of Idaho and was first employed by the Forest Service in 1912. From 1920 until 1935 he was supervisor of several national forests, including Blackfeet, Lewis and Clark, St. Joe, and the Clearwater. In 1935 he became supervisor of the Lolo National Forest and remained in that position until his retirement in 1951.

Mr. Myrick was born in Mapleton, Kan., November 6, 1890.

King, Preston Earl, Elizabeth, La.
Kummel, J. F., Portland, Ore.
Meinecke, E. P., San Francisco, Calif.
Moore, William H. Jr., Glen St. Mary, Fla.
Myrick, E. H., Missoula, Mont.
Nord, A. G., Ogden, Utah
Peck, Ray, Grand Junction, Colo.
Pratt, Walter F., Canton, N. Y.
Swan, O. T., Oshkosh, Wis.
Tinker, Earl W., New York, N. Y.
Wing, Gerald E., Waterville, Maine
Wood, A. P., Ardmore, Pa.
Yarnall, Ira T., Sunbury, Pa.

Junior

Bach, Helmut A. R., Dearborn, Mich.
Brinsfield, William R., Grants Pass, Ore.
Edwards, William J., Monticello, N. Y.
McCormack, Maynard H., Roseburg, Ore.
McFarland, Floyd E., Bakersfield, Calif.

Associate

Jewitt, George Frederick, Spokane, Wash.

Affiliate

Beck, Charles A., Western Port, Md.
Jordan, Carl M., Wells River, Vt.

Ozark Section Holds Winter Meeting

A record attendance of 170 registered members and guests marked the winter meeting of the Ozark Section, held January 24 and 25 at Arkansas Polytechnic College, Russellville, Ark. J. B. Dahl, supervisor of the Ozark National Forest, was chairman of arrangements.

Speaking on the theme "Land Use in the Ozark Highlands," the following persons presented papers: Robert Maple (geology), Howard Miller (wildlife), J. L. Smith (water), Frank Mayfield (recreation), and Clement Mesavage (research), all of the U. S. Forest Service. In addition papers were read by F. M. Meade (reforestation) and A. M. Davis (forage) of the University of Arkansas.

At the Section's annual dinner Osal B. Capps presided as toastmaster. Talks were given by Mark Townsend of Townsend Lumber Company, Stuttgard, Ark. and by Henry Clepper, executive secretary.

Nelson Rogers, Section chairman, presided at the business session which concluded the meeting.

Honorary Member Conveys Thanks

Forstbotanisk Have,
Charlottenlund, Denmark
16th January 1958

Dear Mr. Clepper:

It was a very great pleasure indeed to receive your letter of 7th January. I am quite overwhelmed to obtain this great honor from the Society of American Foresters.

To be elected an Honorary Member of the Society of American Foresters is the greatest kindness you could show me. Having the opportunity to read your JOURNAL OF FORESTRY regularly, I am sure, this will promote a closer contact.

I should be glad if you would express my cordial thanks and regards to the President and the Members of the Council of the Society of American Foresters.

With kind regards,
Sincerely yours,
S/s C. SYRACH LARSEN

BETTER SURVIVAL,
BETTER GROWTH
WITH
ROOTSPRED TREE PLANTERS

ROOTSPRED "Lake States". Scalper reduces competition 15" each side of planted tree.

Talking through our hat? Missouri Conservation Commission owns twenty-four **ROOTSPRED** Standards; Continental Can Co. uses twenty. **ROOTSPREDS** are way ahead with Christmas Tree Growers.

For specifications, prices, photos, write:

ROOTSPRED
St. Petersburg, Pennsylvania

FORESTERS WANTED!

GOOD PAY

EXCELLENT FUTURE FOR YOUNG MEN

SOME TRAVELING

SOUTHERN BACKGROUND PREFERRED BUT NOT ESSENTIAL

Must be between 22-35 years with ability to supervise 4-5 man crew. We pay you for 30-60 day training period. Send us your name and address for full details.

OSMOSE WOOD PRESERVING CO. OF AMERICA, INC.
972 ELLICOTT STREET BUFFALO, N. Y.

Gaylord K. Robertson (1919-1958)

Gaylord K. Robertson, 38, assistant district forester with the Maryland Department of Forests and Parks at Milburn Landing, Pocomoke State Forest, died suddenly on January 3, 1958. He was born in Lytton, Iowa May 31, 1919.

Mr. Robertson obtained the B.S. degree in forestry from Iowa State College in June 1949. After graduation, he accepted employment with the Maryland Department of Forests and Parks on the Eastern Shore of Maryland. He was instrumental in getting pine reforestation underway on the lower eastern shore.

Membership Applications and Advancements

Proposals for admission, advancement, and reinstatements received in the Society office during the month of January are listed below.

Action on the eligibility of those proposed for membership as listed below will be taken by the Council as of April 1958.

Communications from voting members regarding the membership eligibility of these persons should be received in the Society office prior to that date.

Allegheny Section

Student Grade

PENNSYLVANIA STATE UNIVERSITY

Shain, L.

WEST VIRGINIA UNIVERSITY

Maxey, W. R. Wingfield, B. G.
Yeager, J. N.

Junior Grade

Harmon, W. J., Asst. Dist. Forester, Dept. of Forests & Waters, Renovo, Pa.; Univ. of Mich., B.S.F., 1951.

Member Grade

Eschner, A. R., Forester, USFS, Kingston, Pa. (Junior 1951).
Lucas, C., Dist. Forester, Beckley, W. Va. (Junior 1951).
Mansberger, B. E., Forester, USFS, Havertown, Pa. (Junior 1951).
Shogren, P. W., Forester, USFS, Warren, Pa. (Junior 1951).
Stambaugh, W. J., Asst. Prof. of Forest Pathology, Pa. State, State College, Pa. (Junior 1951).
Villesvik, J. U., Forester, W. Va. Pulp & Paper Co., Coudersport, Pa. (Junior 1951).
Wessel, H., Consulting Forester, Philadelphia, Pa. (Junior 1951).
Whitesell, C. D., Research Forester, Md. Board of Natural Resources, Solomons, Md. (Junior 1951).

Appalachian Section

Junior Grade

Crawford, M. M., Area Forester, Continental Can Co., South Hill, Va.; W. Va. Univ., B.S.F., 1950.

Member Grade

Crews, A. C., Forester, Union Bag & Paper Co., Hampton, S. C. (Junior 1951).
Douglass, J. E., Forester, USFS, Union, S. C. (Junior 1951).
Fournier, J. P., Consulting Forester, Chase City, Va. (Junior 1951).
Hance, J. T., Forest Fire Control Asst., S. C. Comm. of Forestry, West Columbia, S. C. (Junior 1951).
Haney, G. P., Forester, USFS, Charlottesville, Va. (Junior 1951).
Harmon, J. B., Bedford, Va. (Junior 1951).
McCombs, R. N., Forester, S. C. Comm. of Forestry, Florence, S. C. (Junior 1951).
Nicholson, J. C., Dist. Supt., W. Va. Pulp & Paper Co., Camden, S. C. (Junior 1951).
Ratliff, W. S., Forester, Flack-Jones Lbr. Co., Summerville, S. C., (Junior 1951).
Reames, W. H., Forester, S. C. Comm. of Forestry, Newberry, S. C. (Junior 1951).
Stacy, W. R., Consulting Forester, Walterboro, S. C. (Junior 1951).
Steigerwalt, M. A., Forester, Gair Woodlands, Ridgeland, S. C. (Junior 1951).
Thornton, D. L., Dist. Ranger, USFS, Newberry, S. C. (Junior 1951).
Westbury, H. M., Dist. Forester, S. C. Comm. of Forestry, Kingstree, S. C. (Junior 1951).

Affiliate Grade

King, J. H., 2nd Lt., U. S. Army, Fort Belvoir, Va.

Central Rocky Mountain Section

Student Grade

COLORADO STATE UNIVERSITY

Cazier, J. R. Solether, R. B.
Hutchins, G. N.

Central States Section

Student Grade

PURDUE UNIVERSITY

Maddock, T. L.

Junior Grade

Students Eligible for Automatic Advancement

PURDUE UNIVERSITY

Harvey, J. F. Hupp, J. S.
Hebert, O. G. Lee, R. P.

Member Grade

Brown, R. C., Forester, D. B. Frampton Co., McArthur, Ohio (Junior 1951).
Cech, G. O., Dist. Forester, Ill. Div. of Forestry, Havana, Ill. (Junior 1951).
Fritz, D. H., Supt. of Parks, Highland, Ill. (Junior 1951).
Funk, D., Research Forester, USFS, Columbus, Ohio (Junior 1951).
Hayford, C. G., Experimental Work of Saw Mill on a Barge, Mt. Vernon, Ind. (Junior 1951).
Marti, D. W., Sales Rep., Edward Hines Lbr. Co., Aurora, Ill. (Junior 1951).
McMillan, F. W., Forest Mgr., Cascade Industries Inc., Beardstown, Ill. (Junior 1951).
Newell, F. P., Farm Forester, Ohio Dept.

3 HALE

WORKHORSES

FOR FIRE FIGHTING FORESTERS

Hale's centrifugal portable pumping units are compact, rugged and quick-starting . . . real "workhorses" for fighting forest, field and brush fires. The FZZ pumps 60 GPM at 90 lbs.—FZ pumps 300 GPM at 10 lbs. —HPZF pumps 15 GPM at 200 PSI —the range of volumes and pressures you need for a wide variety of fires.

Other Hale fire fighting units such as the CFUS, WF and Rotary H & 2HB Boosters (listed below), and other Hale power take-off boosters, have been used by forestry departments to meet their specific fire fighting requirements.

OTHER HALE UNITS

CFUS	600 U.S. GPM at 120 lbs.
WF	150 U.S. GPM at 100 lbs.
H	100 U.S. GPM at 120 lbs.
2HB	200 U.S. GPM at 120 lbs.

Another addition to our line, the

***HALE* "TORRENT"**

Self-priming, portable pumping unit with 1000 auxiliary uses!

The gasoline-driven "Torrent" is ideal for "wetting down" and filling tanks. It features an open impeller which helps prevent "clogging" when pumping muddy or sandy water and requires little or no maintenance.

The unit is lightweight (only 54 lbs.), easy to carry, set-up and use. It is powered with a 2¾ HP 4 cycle engine with a built-in exhaust valve rotator and will pump 7,000 gallons per hour!

Ask for a Demonstration; no obligation.

Send this coupon for our latest circulars

Please send your latest circulars on the Hale Workhorses and the NEW "Torrent." Dept. JF

Name .....

Address .....

Town ..... State .....

HALE FIRE PUMP CO. Conshohocken, Pa.

PLANTING TREES ?
Use a "FORESTER" or "CONSERVATOR" Planter
Complete information on request
UT&BCo
UTILITY TOOL & BODY CO.
Clintonville, Wis.

SILVA COMPASS
Simpler — More Accurate
Recommended by foresters for cruising. Easier to use, faster, positive. Direct course readings. *Write for free literature and instructions.*
SILVA, INC., Dept. J, La Porte, Ind.
RANGER MODEL

BAKED ENAMEL
METAL FORESTRY SIGNS
for WOODLAND BOUNDARY MARKERS—NO TRESPASSING & FIRE WARNING SIGNS—LOCATION MARKERS—CRUISER TAGS—etc., any size to your specifications. WRITE FOR QUOTATIONS ON ALL YOUR SIGN NEEDS. state size and quantity.
A. L. LIND COMPANY
5036 THOMAS AVENUE SOUTH
MINNEAPOLIS 10, MINNESOTA

FOREST SEEDS
of CALIFORNIA
Since 1952
R. S. ADAMS A. P. BAAL
P.O. BOX 561
DAVIS — CALIFORNIA

CUT COSTS 90%
PREVENT ACCIDENTS
• WASH WINDOWS FOUR STORIES HIGH
REMOVE LIGHT GLOBES 60 ft. up
• PRUNE TREES & PICK FRUIT 60 ft. up
Quick-Easy! WATER FLOW BRUSH
HUNDREDS OF USES!
Send for Free Catalog
DEPT. J . 300 S. Los Angeles St. L.A. 13. MA 6-9397

of Natural Resources, Logan, Ohio (Junior 1951).
Paull, J. T., Wood Procurement, Mead Corp., Chillicothe, Ohio (Junior 1951).
Wilson, O. E., Sales Rep., International Paper Co., Hammond, Ind. (Junior 1951).

Columbia River Section

Student Grade

OREGON STATE COLLEGE

Burwell, B. B. Malone, J. E.
Clark, H. L. Murray, M. D.
Gilles, G. C. Pettey, R. A.

Junior Grade

Wittmeyer, J. G., Forester, Bur. of Land Mgmt., Coos Bay, Ore. (Reinstatement).

Member Grade

Black, E. D., Forester, Bur. of Land Mgmt., Roseburg, Ore. (Junior 1951).
Clocksin, D. B., Forester, Crown, Zellerbach Corp., Molalla, Ore. (Junior 1951).
Collins, D. H., Forester, Bur. of Land Mgmt., Salem, Ore. (Junior 1951).
Feeney, C. R. T., Forester, Bur. of Land Mgmt., Salem, Ore. (Junior 1951).
Herstine, R. B., Forester, Bur. of Land Mgmt., Salem, Ore. (Junior 1951).
Johnson, W. R., Forester, Bur. of Land Mgmt., Portland, Ore. (Junior 1951).
Larson, A. G., Forester, Bur. of Land Mgmt., Salem, Ore. (Junior 1951).
Palmer, R. L., Forester, Ore. State Tax Comm., Salem, Ore. (Junior 1951).
Patton, D. L., Forester, Bur. of Land Mgmt., Medford, Ore. (Junior 1951).
Schaefer, R. E., Forester, Ore. Pulp & Paper Co., Salem, Ore. (Junior 1951).
Stoebig, R. W., Resident Forester, Ore. Pulp & Paper Co., Gleneden Beach, Ore. (Junior 1951).
Stryker, R. K., Chief Forester, Ore. Pulp & Paper Co., Vancouver, Wash. (Junior 1951).
Sweningson, R. T., Forester, Bur. of Land Mgmt., Burns, Ore. (Junior 1951).
Valentine, R. R., Forester, State of Ore., Salem, Ore. (Junior 1951).

Gulf States Section

Student Grade

LOUISIANA POLYTECHNIC INSTITUTE

McKinnon, K. R.

Junior Grade

Students Eligible for Automatic Advancement

LOUISIANA STATE UNIVERSITY

Barnett, J. P. Touliatos, P. D.

Member Grade

Briscoe, C. B., Asst. Prof., School of Forestry, LSU, Baton Rouge, La. (Junior 50R53).

Affiliate Grade

Davis, S. W., Woods Supt., Dixie Pine Products, Inc., Hattiesburg, Miss.
McIntyre, J. L., Asst. Forester, Texas Forest Service, Woodville, Texas.

Inland Empire Section

Student Grade

UNIVERSITY OF IDAHO

Barclay, W. A. Stairs, W. D.
Finn, R. A. Stroup, S. W.
Kokko, G. K. Volland, L. A.
Westhaver, B. L. T.

Intermountain Section

Member Grade

Dahlgreen, A. K., Forest Ranger, USFS, McCall, Idaho (Junior 1951).
Estep, E. M., Asst. Forest Ranger, USFS, Idaho City, Idaho (Junior 1951).
Furniss, M. M., Entomologist, USFS, Boise, Idaho (Junior 1951).

Kentucky-Tennessee Section

Member Grade

Baird, C. O., Instructor in Forestry, Univ. of the South, Sewanee, Tenn. (Junior 1951).
Bartley, W. G., Industry Forester, Kingston, Tenn. (Junior 1951).
Brown, W. L., Industry Forester, Calhoun, Tenn. (Junior 1951).
Crowell, S. F., Wartrace, Tenn. (Junior 1951).
Emond, R. J., Red Bank, Tenn. (Junior 1951).
Fox, J. A., Forester, Tenn. Div. of Forestry, Lexington, Tenn. (Junior 1951).
Hawkins, W. Z., Forester, Nickey Bros. Inc., Memphis, Tenn. (Junior 1951).
Hicks, N. M., Forester, E. L. Bruce Co., Memphis, Tenn. (Junior 1951).
Int-Hout, P. B., USFS, Tellico Plains, Tenn. (Junior 1951).
Smith, H. W., Instructor, Forestry School, Univ. of the South, Sewanee, Tenn. (Junior 1951).

New England Section

Student Grade

UNIVERSITY OF MAINE

Hall, L. R.

Junior Grade

Woodsum, K. Y., Farm Forester, Maine Forest Services, So. Portland, Maine; Univ. of Maine, B.S.F., 1955.

Student Eligible for Automatic Advancement

UNIVERSITY OF MASSACHUSETTS

Duckworth, R.

Member Grade

Barlow, K. J., Owner Mgr., Ashland Lbr. Co., Plymouth, N. H. (Junior 1951).
Bates, J. D., Chief Scaler, Brown Co., Berlin, N. H. (Junior 1951).
Burt, R. H., Forester, Allen Rogers Corp., Laconia, N. H. (Junior 1951).
Carpenter, E. M., Dist. Forester, Mass. Forest Service, Rehoboth, Mass. (Junior 1951).
Dixon, A. C., Research Forester, Canadian Federal Forestry Branch, Campbellton, N. B., Canada, (Junior 1951).
Eisenmenger, R. W., Forest Economist, Federal Reserve Bank, Boston, Mass. (Junior 1951).
Farrington, R. A., Asst. State Forester, Dept. of Forests & Parks, Montpelier, Vt. **(Reinstatement).**
Gabriel, W. J., Research Forester, USFS, Milton, Vt. (Junior 1951).
Goodrich, R. S., Dist. Forest Ranger, USFS, Gorham, N. H. (Junior 1951).

Gullion, B. S., Service Forester, Mass. Dept. of Natural Resources, Pittsfield, Mass. (Junior 1951).
Hannon, L. P., Service Forester, Mass. Dept. of Natural Resources, Ipswich, Mass. (Junior 1951).
Sleight, C. K., Forester, Eastern Corp., Milltown, Maine. (Junior 1951).
Sutherland, K. I., Forester, USFS, Plymouth, N. H., (Junior 1951).

Associate Grade

Pearson, F. E., V. P. & Mgr., Eastern Pulpwood Co., Calais, Maine.

New York Section

Student Grade

STATE UNIVERSITY OF NEW YORK

Opdycke, J. B.

Northern Rocky Mountain Section

Student Grade

MONTANA STATE UNIVERSITY

Taylor, A. R.

Junior Grade

Feilzer, R. A., Forester, USFS, Rexford, Mont.; Univ. of Minn., B.S.F., 1953.

Students Eligible for Automatic Advancement

MONTANA STATE UNIVERSITY

Bond, D. S. Slajer, C. E.

Member Grade

Burnell, F. F., Asst. Ranger, USFS, Kalispell, Mont. (Junior 1951).
Dawson, A. L., Forester, Anaconda Co., Missoula, Mont. (Junior 1951).
Dewey, J. E., Asst. Ranger, USFS, Coram, Mont. (Junior 1951).
Dratz, W. D., Forester, Missoula White Pine Sash Co., Missoula, Mont. (Junior 1951).
Emerson, J. L., Dist. Ranger, USFS, St. Regis, Mont. (Junior 1951).
Hakenson, C. G., Proj. Forester, Diamond Match Co., Superior, Mont. (Junior 1951).
Hanson, R., Forester, Blackfoot Protective Assoc. (Junior 1951).
Olson, A. H., Dist. Ranger, USFS, Kalispell, Mont. (Junior 1951).
Straton, H. W., Staff Supv.'s Office. Hamilton, Mont. (Junior 1951).
Sullivan, M. J., Forester, Intermountain Lbr. Co., Missoula, Mont. (Junior 1951).
Van Gieson, B. R., Dist. Ranger, USFS, Condon, Mont. (Junior 1951).

Ozark Section

Member Grade

Fox, G., Eng., Ark. Assessment Coordination Dept., Little Rock, Ark. (Junior 1951).
Hester, J. E., Asst. Wood Procurement Supt., Pine Bluff, Ark. (Junior 1951).
Miller, M. M., Unit Forester, International Paper Co., Idabel, Okla. (Junior 1951).
Padgett, J. R., Dist. Ranger, USFS, Paris, Ark. (Junior 1951).
Purcell, W. W., Dist. Supv., International Paper Co., Pine Bluff, Ark. (Junior 1951).

Affiliate Grade

Geiger, G. H., USAF, Fort Sill, Okla.
Kleinhofs, J., Asst. Dist. Forester, Crossett Lbr. Co., Crossett, Ark.

Puget Sound Section

Student Grade

UNIVERSITY OF WASHINGTON

Anderson, W. L. Carlson, R. A.

Junior Grade

Peterson, R. R., Inventory Forester Asst., Weyerhaeuser Tbr. Co., Tacoma, Wash.; Iowa State, B.S.F., 1954.
McCarty, H. J., Forester, Bur. of Indian Affairs, Toppenish, Wash.; Utah State, B.S.F., 1949.
Wonn, R. W., Eng., Structural Design, American Fabricators, Bellingham, Wash.; Univ. of Wash., B.S. (Forest Prod.), 1937.

Member Grade

Bennett, S. M., Forest Eng., USFS, Okanogan, Wash. (Junior 1951).
Bevan, J. S., Forester, Poles & Piling Co., Edmond, Wash. (Junior 1951).
Curry, W. L., Farm Forester, Wash. Div. Natural Resources, Sumner, Wash. (Junior 1951).
Dickinson, F. E., USFS, Port Angeles, Wash. (Junior 1951).
Misa, Frank, Forester, Crown Zellerbach Corp., Port Angeles, Wash. (Junior 1951).
Morgan, D. W., Forester, West Tacoma Newsprint, Tacoma, Wash. (Junior 1951).
Oldroyd, R. W., Forester, West Tacoma Newsprint, Tacoma, Wash. (Junior 1951).
Rave, R. A., Forester, Co. Assessor, Tacoma, Wash. (Junior 1951).
Rising, R. P., Salesman, Elliott Bay Mill Co., Seattle, Wash. (Junior 1951).
Schwab, C. A., Forester, Wash. Div. of Natural Resources, Olympia, Wash. (Junior 1951).
Tanner, R. S., Forester, Simpson Logging Co., Shelton, Wash. (Junior 1951)
Warman, D. A., Dist. Ranger, USFS, Hoodsport, Wash. (Junior 1951).
Warner, L. H., Dist. Ranger, USFS, North Rend, Wash. (Junior 1951).
Zepeda, H. A., Mgmt. Forester, Wash. Div. of Natural Resources, Omak, Wash. (Junior 1951).
Zitkovitch, S. J., Tbr. Mgmt., USFS, Leavenworth, Wash. (Junior 1951).

Affiliate Grade

Hass, B. J., Land Supv., Weyerhaeuser Tbr. Co., Eatonville, Wash.
Lenz, L. L., Forester, USFS, Naches, Wash.
Robinson, T. B., Forester, USFS, Ketchikan, Alaska.

Southeastern Section

Junior Grade

Student Eligible for Automatic Advancement

UNIVERSITY OF GEORGIA

Freeman, H. D.

Member Grade

Anderson, C. W., Dist. Supv., Opelika, Ala. (Junior 1951).
Arnold, B. L., Forester, Mobile, Ala. (Junior 1951).
Bailey, H. B., Cons. Forester, Tifton, Ga. (Junior 1951).

Transplant your Seedlings the Practical — Economical Way —
THE MECHANICAL WAY
Write for latest folders and prices.
MECHANICAL TRANSPLANTER COMPANY
S. Central at U. S. 31
Holland Michigan

REGULATION FIELD CLOTHES
for
U. S. FOREST SERVICE PERSONNEL
Complete Price List on Request
THE FECHHEIMER BROS. CO.
UNIFORMS FOR OVER 75 YEARS
CINCINNATI 2, OHIO

FOR SALE
Slash, Loblolly, Longleaf
and
Shortleaf Pine Seed
In Wholesale Quantities
Treated with Rodent and Bird Repellent For Direct Seeding
For over ten years
a dependable source
for
Southern Pine Seed
SOUTHERN SEED COMPANY, INC.
Baldwin, Georgia

COMPLETE INVENTORY CRUISING SCALE

Hypsometer Biltmore Scale
Rigid When Open
Flexible 6-foot Steel Tape $3.00 EACH
Handy Chrome-plated Case 1¾" Dia.
CARL W. GETZ, President
KURFEW, INC.
Lansdale, Pa.

Brendemuehl, R. H., Research Forester, Marianna, Fla. (Junior 1951).
Brightwell, C. N., Ext. Forester, Tifton, Ga. (Junior 1951).
Carlson, B. D., Eng. & Protection Supt., Coosa River Newsprint Co., Sylacauga, Ala., (Junior 1951).
Crouch, J. E., Asst. Area Forester, Coosa River Newsprint Co., Centreville, Ala. (Junior 1951).
Culpepper, T. R., Eight Mile, Ala. (Junior 1951).
Deason, J. W., Forester, Plantersville, Ala. (Junior 1951).
Dunn, R. W., Forester, Ga. Kraft Co., Macon, Ga. (Junior 1951).
Eadie, F. H., Dist. Forester, Milledgeville, Ga. (Junior 1951).
Fickett, S. B., Game Tech., Brooksville, Fla. (Junior 1951).
Hargraves, J. F., Forester, St. Marys, Ga. (Junior 1951).
Harper, W. C., Dist. Forester, Ga. Forestry Comm., Statesboro, Ga. (Junior 1951).
Harris, G. M., Consulting Forester, Tallahassee, Fla. (Junior 1951).
Haynes, J. A. Q., Res. Forester, Butler, Ala. (Junior 1951).
Henson, J. A., Dist. Forester, Ga. Forestry Comm., Newnan, Ga. (Junior 1951).
Jefferies, R. H., Forester, Milledgeville, Ga. (Junior 1951).
Jones, D. E., Forester, Locke-Laird Tbr. Co., Cottondale, Ga. (Junior 1951).
Kennedy, T. B., Dist. Supv., International Paper Co., Thomasville, Ga. (Junior 1951).
Luke, K. E., Forester, Mobile, Ala. (Junior 1951).
Manning, R. W., Asst. Dist. Forester, Newnan, Ga. (Junior 1951).
McLead, C. J., Forest Tech., International Paper Co., Bainbridge, Ga. (Junior 1951).
Pearce, N. D., Forester, Opelika, Ala. (Junior 1951).
Riley, O. L., Consulting Forester, Pine Mt. Valley, Ga. (Junior 1951).
Stokes, J. M., Asst. Dist. Forester, Ga. Forestry Comm., Waycross, Ga. (Junior 1951).
Tucker, J. J., Wood Procurement Supt., Panama City, Fla. (Junior 1951).
Turpin, D. H., Forester, Brewton, Ala. (Junior 1951).
Uhler, J. R., Mgr. Woodlands Div., Milledgeville, Ga. (Junior 1951).
Weybrecht, P., Forest Eng., Jacksonville, Fla. (Junior 1951).
Willett, D. V., Forester, Gulf States Paper Co., Tuscaloosa, Ala. (Junior 1951).

Affiliate Grade

Martin, D. N., Asst. Forester, U. S. Pipe & Foundry Co., Vance, Ala.

Southern California Section

Member Grade

Brewer, T. M., Long Beach, Calif. (Junior 1951).
Ebnet, J. M., Redondo Beach, Calif. (Junior 1951).
Merriam, R. A., Tech., USFS, Glendora, Calif. (Junior 1951).
Norman, R. H., Glendale, Calif. (Junior 1951).
Rehbein, D., Alhambra, Calif. (Junior 1951).

Upper-Mississippi Valley Section

Student Grade

UNIVERSITY OF MINNESOTA

Bodine, R. O. Koller, N. F.
Groothousen, C. P. Nelson, C. G.
Hoelzel, F. W. Roettgering, B. H.
Skinner, R. W.

Junior Grade

Rice, R. L., Student, Univ. of Minn. B.S.F., 1957.

Student Eligible for Automatic Advancement

UNIVERSITY OF MINNESOTA

Kuyova, J. G.

Member Grade

Burton, J. D., Associate in Forestry, Iowa State, Ames, Iowa (Junior 1951).
Dickinson, S. K., Forester, Pickand-Mather & Co., Aurora, Minn. (Junior 1951).
Johnson, L. A., Asst. Ranger, USFS, Ely, Minn. (Junior 1951).
Lundgren, A. L., Forester, USFS, Grand Rapids, Minn. (Junior 1951).
Meyer, M. P., Assoc. Prof., School of Forestry, Univ. of Minn., St. Paul, Minn. (Junior 1951).
Nelson, R. C., St. Paul Park, Minn. (Junior 1951).
Rowe, R. W., Forestry Asst., Co. Land Comm., Brainerd, Minn. (Junior 1951).
Rozeboom, W. B., Sales Rep., Osmose Wood Preserving Co., Brainerd, Minn. (Junior 1951).
Seed, G. K., Forester, Dryden Paper Co., Dryden, Canada. (Junior 1951).
Sliney, W. J., Asst. Co. Agent, Bemidji, Minn. (Junior 1951).
Spangler, J. E., Reg. Forester, Minn. Forest Service, Brainerd, Minn. (Junior 1951).
Tucker, J. C., Forester, Kimberly-Clark, Duluth, Minn. (Junior 1951).

Wisconsin-Michigan Section

Student Grade

MICHIGAN STATE UNIVERSITY

Wheatley, G. N.

Junior Grade

Brink, L. K., Forester, American Box Board Co., Stronach, Mich. (Affiliate 1955).
Hauge, C. T., Forester, Wis. Cons. Dept., Tomahawk, Wis.; Mich. College of Mining & Tech., B.S.F., 1957.

Students Eligible for Automatic Advancement

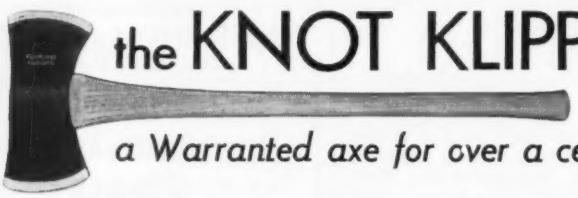
MICHIGAN STATE UNIVERSITY

Chorman, D. H. Kauma, T.
Harrington, D. C. Morehouse, P. H.
Warth, H. O.

Member Grade

Borgerson, H. V., Dist. Forester, Mich. Dept. Cons., Roscommon, Mich. (Junior 1951).
Noblet, J. C., Land Mgr., Calumet & Hecla Inc., Goodman, Wis. (Junior 1951).
Pepper, A. A., Dist. Forester, Wis. Cons. Dept., Park Falls, Wis. (Junior 1951).

This is the axe that "Experience" Built!



the KNOT KLIPPER

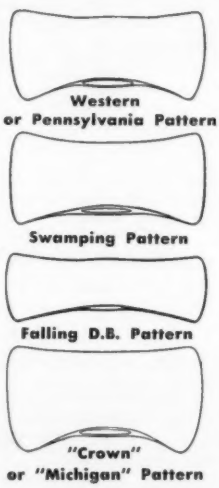
a Warranted axe for over a century.

When the MANN factory first began making the axes that blazed many of America's pioneering trails, this KNOT KLIPPER was its finest grade. A century of experience has toughened the steel, brought about new methods of providing a keener, more durable edge, developed harder and more resilient handles, and recent technology has made possible a precision-balanced handle insertion that prevents "eye" breaking.

Actually, MANN axes are made today—in 1957—by sons of sons of the first plant . . . down to the fifth generation.

This is a heritage of quality we believe to be unequalled in any other axe made today. And the KNOT KLIPPER is the finest product they produce. Ask your jobber or wholesaler; sold only through authorized dealers.

The KNOT KLIPPER is available in all patterns outlined.



MANN EDGE TOOL CO.

LEWISTOWN 5, PENNSYLVANIA

Makers of the "Paul Bunyan" line of axes

Two-man, TD-9 Skid-Grapple "show" ...succeeds in scattered stands!

The TD-9 Skid-Grapple loading a log on the Brewer truck. They've proved their Skid-Grapple can load a 1,000-bf log with ease!

Large tracts of big timber were scarce—small tracts of smaller timber were more plentiful. So, G. K. Brewer and Son, Fall Creek, Oregon, abandoned their larger operation—converted to a two-man, one-machine "show!"

"We are making more money with our two-man operation and International Drott TD-9 Skid-Grapple than we did with a larger crew and more equipment," report the Brewers.

"Our TD-9 Skid-Grapple can load trucks anywhere. While the truck is off to the sawmill the Skid-Grapple becomes a skid tractor that brings out tree-length logs, to be bucked at the landing.

The G. L. Brewer and Son International Drott TD-9 Skid-Grapple skidding tree-length logs in a stand of small timber.

"The two of us do everything—falling, skidding, bucking, loading, and hauling. We average 10,000 bf daily in small timber tracts.

"We're doing fine, thanks to the multi-purpose International Drott Skid-Grapple."

Prove to yourself the man-saving capacity and versatility of an International Drott Skid-Grapple. Compare exclusive top grab-arm action for positive load-control and operating ease. Measure International crawler bonus power advantages for all-weather, all-terrain loading and skidding. See how exclusive Hydro-Spring swallows shock, protects performance. Ask your International Drott Distributor for a Skid-Grapple demonstration.

International Harvester Company, Chicago 1, Illinois
Drott Manufacturing Corp., Milwaukee 15, Wisconsin

INTERNATIONAL HARVESTER

INTERNATIONAL®
DROTT®

Forestry News

Private & Industrial

Southern Pulpwood Conservation Association Meets

More than 500 members and guests, most of them foresters, attended the annual meeting of the Southern Pulpwood Conservation Association, held in Atlanta, Ga., January 14-16.

At the session of conservation foresters papers were presented by J. H. Johnson of Chesapeake Corporation of Virginia; C. R. Mordecai, Jr. of Union Bag-Camp Paper Corporation; and Jeet Rowell and George Faure, both of International Paper Company.

During the general sessions reports and addresses were made by President R. C. Barienbrock of Mead Corporation; Henry J. Malsberger, manager of the association; Frank Heyward, Jr. of Gaylord Container Corporation; D. A. Craig of the U. S. Forest Service; and R. Vance Miles, Jr. of Gulf States Paper Corporation.

Jonathan Daniels, editor of the Raleigh, N. C. *News and Observer* discussed the economic importance of the industry in the South. At the association's banquet on January 15, W. M. Bailey of International Paper Company presided as toastmaster.

President Barienbrock was succeeded in office by L. A. Whittle of Brunswick Pulp and Paper Company.

Scott Paper Foresters Promoted

Scott Paper Company has announced the appointment of Karl A. Swenning as director of timberlands, and James G. Rowbury as staff forester.

Swenning has been active in forest management since his graduation from the College of Forestry at Syracuse University in 1920. He became associated with Scott through its Hollingsworth & Whitney Division, which he joined in 1943. Formerly general woods manager for Scott's woods operations in Maine and the South, he will now direct staff activities related to the company's entire woods management function.

Rowbury, who will serve as Swenning's assistant, is a forestry graduate of the University of California and the University of Michigan. With Scott since 1948, he has most recently been chief forester of the company's West Coast division.

KARL A. SWENNING

Stuart Moir Resigns From Western Forestry

Stuart Moir, forest counsel for the Western Forestry and Conservation Association since April 1948, submitted his resignation at the annual session of that organization held recently in Seattle, Wash. Carl V. Hersey, secretary-manager of the association, has been appointed acting head until a new forester is appointed.

Moir has had a very active career in forestry for the past 35 years. Following one and a half years in Scandinavian countries studying forest management and operations, he joined Laurentide Paper Co., Ltd., at Grand Mere, Quebec, where he developed plans for a pulp operation.

Mark continuously, tap-tap-tap, 100 logs a minute or just an occasional log as required. End the waste motion of dip-drip-and-splash from open buckets. Light tap of porous spotter makes bright, durable paint mark. Cuts time 75% — saves 75% on paint.

TRY IT — WRITE . . .

THE NELSON COMPANY
IRON MOUNTAIN 13, MICH.

TM MODEL

Lowther Heavy duty tree planters insure deep penetration and straight root systems.

Our Sod Scalpers aid survival and growth.

Six distinctly different models available to cover all soil and terrain conditions.

For details write

HARRY A. LOWTHER COMPANY
BOX 1412, JOLIET, ILLINOIS

Among the first to become interested in the use of aircraft in forest fire detection and surveying he helped pioneer the work, later spending several years in commercial aerial surveys and engineering in Canada, the United States, Mexico, and Central America.

Timber management and logging called him back to the West when he became district forest engineer in California for the Western Pine Association. Following that he became associate regional conservator for the Soil Conservation Service.

Subsequently he was director of soil conservation for the Department of the Interior, leaving that post in 1938 to become Western Pine's chief forester with offices in Portland. It was from there that he moved into the office of the WFCA.

Tree Farm Program Shows Steady Gain

The industry-sponsored Tree Farm program gained 3,399,700 acres in 1957, reaching a total of 44,947,917 acres in 45 states it has been announced by C. A. Gillett, managing director of American Forest Products Industries, sponsor of the program.

The year-end figures showed 11,163 certified tree farmers, including individual landowners and forest industries.

Florida, first state to pass the 4 million-acre mark in certified Tree Farms, maintained leadership with 4,519,798 acres. Other leaders include Georgia, 3,909,193 acres; Oregon, 3,861,832 acres; Alabama, 3,832,694 acres; Washington, 3,775,916 acres; Texas, 3,630,695 acres, and Arkansas, 3,422,667 acres.

Mississippi continued to lead in the number of Tree Farms enrolled with 1,177. Texas dedicated its 1,000th Tree Farm in November.

Oklahoma became the 45th state to activate the Tree Farm movement. With formal launching this spring, Delaware will become the 46th.

Wood Industry Progress Conference Scheduled

A conference dealing wholly with progress in the wood industry will be held March 30-April 1, 1958, at the Hotel Syracuse in Syracuse, N. Y. Jointly sponsored by the Wood Industries Division of The American Society of Mechanical Engineers, the Eastern Canadian Section of the Forest Products Research Society, and the Northeast Section of the Forest Products Research Society, the event is expected to attract several hundred people.

Features include reports on "A Camera View of Russia's Forest Industries"—an eyewitness account by the chief of Canada's forest products laboratories; "Granuplast Molding"; "Performance of Circular Saws"; and surveys of laminating progress, abrasives. Two panel discussions, "Basic Wood Research," and "Toubleshooting in Gluing," are also on the program.

On the last day of the meeting, participants will visit the Hugh P. Baker Laboratory of the New York State College of Forestry at Syracuse to see demonstrations of modern equipment and techniques for exploring the physical and chemical properties of wood.

At the meeting's most important social occasion, the banquet on March 31, Dr. Frank H. Kaufert, president of the Forest Products Research Society, and James N. Landis, president of The American Society of Mechanical Engineers, will address the guests.

AMERICAN Box Board Company forest and wildlife ecologist Casey E. Westell, Jr. (*left*), Manistee, Mich., received a Soil Conservation Certificate of Merit from the State Association of Soil Conservation Districts at their annual meeting in East Lansing, Mich., in January.

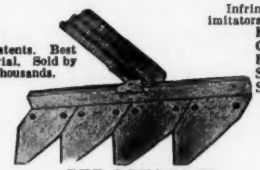
Awards Chairman Benner, Lenawee Soil Conservation District, in making the presentation said that Westell had impressed the Association with his "devotion to the cause of good land use" and effectively demonstrated that "the forest resources of Northern Michigan may be developed to the mutual advantage of industry, recreation, and the farmer."

Westell heads the American Box Board Company's program to coordinate game and timber planning for private landowners.

Economist to St. Regis Position

St. Regis Paper Company announces that Gerald S. Gilligan has joined the Company as market analyst and economist. Mr. Gilligan was formerly senior economist and head of Forest Products Economics at Stanford Research Institute with headquarters at Portland, Ore. He was project leader on the S.R.I. report prepared for the Weyerhaeuser Timber Company, titled: "America's Demand for Wood 1929-1975."

He will have his headquarters at St. Regis' New York office.



THE RENOWNED
CHARLES H. RICH
"Forest Fire Fighting Tool"
Write for Prices and Descriptions
C. H. RICH FOREST FIRE TOOL CO.
218 W. Bald Eagle St.
Lock Haven, Pa.

PACIFIC WEATHER SERVICE
WEATHER: Forecasts—Warnings—Modification.
Fire Danger Rating—Instruments
J. B. "Ben" Melin, Meteorologist
1222 N.E. 117th Ave., Portland 20, Oregon
AL. 2-5410

Fight Fires—With Dirt
"Hold That Line—With DIRT"
16 mm. Color Sound Motion Picture
$85.00 FCDA approved—Preview Free
FIRE-FIGHTING FILMS
74 President Street, New Rochelle, New York

TREES FOR FOREST PLANTING
PINE•SPRUCE
We have grown Pine, Spruce and other conifers for 50 years.
KEENE FORESTRY ASSOCIATION
BOX 378, KEENE, NEW HAMPSHIRE

CHRISTMAS TREE SEEDLINGS
PLANT A CROP WITH A FUTURE!
Growing Christmas trees beautify idle land, earn satisfaction and profits. We offer a wide variety of seedlings and transplants.
Write today for Price List and Planting Guide.
PAINT CREEK NURSERIES
R. D. 1 SHIPPENVILLE, PA.

Consulting Foresters

Professional Services Offered by
Members of the Society of American Foresters

Land Surveyors *Consulting Forest Engineers*

BELANGER and BOURGET

86 MOUNTAIN HILL, QUEBEC,
P.Q., CANADA

Forest Surveys and Inventories. Establishing of boundary lines.

Forest Management and Logging plans. Locations for Wood industries.

POMEROY & McGOWIN

FOREST MANAGERS

Monticello, Arkansas Chapman, Alabama

KEITH CRANSTON, Forestry Consultant

Service to Industry — Personnel Placement
1. Listing of men available for jobs
2. Listing of jobs and employment possibilities

Leland, Mississippi — Headquarters in the Delta Hardwoods

A Southwide Professional Service

GEORGE BANZHAF & COMPANY

622 North Water Street MILWAUKEE 2 BRoadway 6-2062

Consultants to the Wood Using Industries

CONSULTANTS in
FORESTRY and ARBORICULTURE

Appraisals
Forest Inventories
Timber Cruising Service
Site Planning
Landscape Development Plans
Municipal Shade Tree Programs

North Eastern States

CAPITAL FORESTRY CO., INC.
2967 TROY ROAD, SCHENECTADY 9, N. Y.

Est. 1930 E. L. HANDY, *President* Phone STate 5-8281

TIMBERLAND MANAGEMENT, INVENTORY AND APPRAISAL
—OVER 50 MILLION ACRES SINCE 1910

JAMES W. SEWALL COMPANY
FOREST ENGINEERS
OLD TOWN, MAINE

BRANCH: JAMES W. SEWALL CO. (CANADA) LTD., FREDERICTON, NEW BRUNSWICK

New Executive Secretary of Pulp and Paper Association

Robert E. O'Connor has been named executive secretary of the American Pulp and Paper Association. He fills the vacancy created by the death of Earl W. Tinker December 31, 1957.

O'Connor has been associated with the organization for the past ten years and served as assistant executive secretary in recent years.

Industry Land Supports Heavy Sportsman Use

More than 13,000 Oregon and Washington sportsmen hunted on Crown Zellerbach's 12 Northwest tree farms during the 1957 hunting season. They bagged a total of 2,264 big game animals, including 1,609 deer, 455 elk, 162 bear, 27 coyotes, and 11 bobcats.

Clarence W. Richen, manager of the company's Northwest timber operations, said "All of our tree farms were open to hunters and fishermen in 1957, continuing Crown Zellerbach's long established policy of recreational use of its lands."

Total deer harvest and number of hunters declined in 1957 compared with the 17,000 hunters and their bag of 2,815 deer in 1956. Foresters said this drop was caused by postponement of the Oregon deer season to a later date because of dangerous fire conditions on the scheduled opening day. The elk score was up from 410 in 1956 to 500 last year.

George H. Schroeder, Crown Zellerbach's chief forester, reported three hunter-caused fires with less than an acre burned. In one case, Schroeder said, a pair of hunters spotted a fire, notified company fire wardens and fought the blaze until fire protection crews arrived to extinguish it. He said the hunters' prompt action averted what could have been a serious fire.

Weston Receives South Mississippi Award

J. Roland Weston, consulting forester of Bay St. Louis, Miss., received the 1957 South Mississippi Forestry Award for outstanding contributions to forestry in that section of the state. The presentation was made at the South Mississippi Forestry Field Day held on the Harrison Experimental Forest near Gulfport October 31.

Weston was the first person from Mississippi ever to receive a degree in technical forestry. He attended the University of Washington.

Public

Supervisor Shift on Black Hills National Forest

Grant A. Morse, forest supervisor of the Black Hills National Forest at Custer, S. Dak., has been promoted to assistant regional forester in the U. S. Forest Service Regional Office in San Francisco. His new assignment is chief of the Division of Information and Education. Howard C. Lee, staff assistant on the Boise National Forest at Boise, Idaho, replaces Morse at Custer.

Regional Forester Donald E. Clark announced these personnel changes in the Rocky Mountain Region and said the moves were effective about the middle of February.

Morse transferred to forest supervisor at Custer from a similar position on the Targhee National Forest in Idaho in 1955.

Howard Lee, who will succeed Morse at Custer received a BS degree in forestry at the University of California in 1932 and an MS degree in forestry from Yale University. He has served with the Forest Service since 1933.

Heads Lake States Disease Research

Dr. Ralph L. Anderson, plant pathologist at the Lake States Forest Experiment Station for the past five years, has been appointed chief of the Division of Forest Diseases at the Station. This was announced in January by Director M. B. Dickerman.

A graduate of the School of Forestry at the University of Minnesota, Dr. Anderson conducted research for several years on forest diseases for the University and for the Bureau of Plant Industry, U. S. Department of Agriculture. After obtaining a Ph. D. degree in plant pathology in 1952 from the University, he was appointed to the staff on the Lake States Station to take charge of forest disease research and surveys.

RALPH L. ANDERSON

Receives Meritorious Service Award

Alfred E. Fivaz, industrial specialist, Forest Products Division, U. S. Department of Commerce, was, in February, recipient of that Department's Silver Medal Meritorious Service Award. Mr. Fivaz has also been named to serve as a member of the President's Conference on Occupational Safety, scheduled to meet in Washington, D. C. March 25-27.

Forester Participates In Manager Development Program

Robert D. Hostetter, Bureau of Land Management, Medford, Ore., is participating in the Department of the Interior's 1958 manager development program being conducted in Washington, D. C.

Conducted jointly with the U. S. Civil Service Commission, the program is designed to develop executive capabilities among persons in the middle levels of federal service. Hostetter, the only forester in the 11-member group, is currently responsible for resource management planning in the million-acre Medford Forest District. He is chairman of the Columbia River Section, SAF.

R. B. SHANNON & ASSOCIATES
KITTANNING, PA.
REGISTERED SURVEYING
CONSULTING FORESTRY
PHOTOGRAMMETRIC
CARTOGRAPHY
Phone: Kittanning 42-4941

JOHN G. GUTHRIE
Consulting Forester
BOX 517 WIGGINS, MISS.
PHONE WALNUT 8-4958

PAUL T. WINSLOW
Consulting Forest Engineer
ESTIMATES—APPRAISALS—MANAGEMENT
STAATSBURGH-ON-HUDSON, N. Y.

POND & MOYER CO., INC.
Consulting Foresters
Estimates—Appraisals—Surveys
Machine Tree Planting Service
107 HOMESTEAD RD., ITHACA, N. Y.

WILLIAM J. BOZETT
Consulting Forester
Member, Association of Consulting Foresters
Timber Management & Marketing
LOGAN OHIO

PAUL M. SANDERS
Consulting Forester
916 YEON BLDG.
PORTLAND 4, OREGON
Telephone: CApitol 8-3536

NORTHERN TREE COMPANY
Professional Forestry Services
Thomas F. Schweigert, Pres.
Member, Association of Consulting Foresters
Penney Building
Petoskey Michigan

Porcius F. Crank, Jr.
Consulting Forester
Point Harbor North Carolina

ROBERT F. KNOTH & CO.
Foresters — Timber Cruisers — Appraisers — Surveyors
Domestic and Foreign Timber Data
CHARLESTON SOUTH CAROLINA

ADIRONDACK FORESTRY, INC.
David E. Strong Donald E. Peterson
Consultants
Estimates, Appraisals, Marketing
Management Plans, Tree Planting, Preservation
WILMINGTON, NEW YORK

Consulting Forester Forest Surveyor
JOHN STOCK
Specializing in Adirondack Forest and Tax Problems
Box 311 Tupper Lake, N. Y.

ALBERT G. HALL
Forestry Relations Counsel
Consulting Forester
Member, Association of Consulting Foresters
810 18th St., N.W., Washington 6, D.C.

LOGGING COST ESTIMATES APPRAISALS
SURVEYS AND MANAGEMENT CRUISING
INTERMOUNTAIN TIMBER SERVICE
Know Your Timber Values and Logging Costs
THOMAS (Tom) C. CLIFTON Tel. 2-4300
Consulting Forester 4101 State St.
Boise, Idaho

WILLIAM H. PRICE
FOREST MANAGEMENT
Specializing in
Timber Tax Problems
2626 W. Lynn—Seattle 99, Wash.
Al der 7482

WILLIAM A. EASTMAN, JR.
Consulting Forester
Complete Professional Service
SEATTLE 1, WASHINGTON
410 J. GREEN BUILDING
'Phone SEneca 2814

TIMBER MANAGEMENT SERVICE
R. W. MEZGER
Consulting Forester
Member, Association of Consulting Foresters
Klamath Falls, Oregon

FRANK J. LEMIEUX
Forester
833 WHITNEY BUILDING
NEW ORLEANS, LA.

THOMAS G. CLARK,
CONSULTING FORESTER
FOREST LAND
MANAGEMENT CO.
P. O. BOX 1046
MORGANTOWN, W. VA.

GAINESVILLE, FLA.— F. E. Wilson, district agent for the Seaboard Airline Railroad Co., is shown presenting a copy of the railroad's Forestry Bulletin for November to University of Florida President, J. Wayne Reitz, far right. The issue features the work of the University School of Forestry. Looking on are provost for agriculture, Willard Fifield, second from left, and Dr. C. M. Kaufman, school director, third from left. The presentation took place in the University president's office.

Boise National Forest Supervisor Retires

Retirement of Kester D. Flock, Boise National Forest supervisor, Boise, Idaho, effective March 1, was announced in January by Regional Forester Floyd Iverson, Intermountain Region, U. S. Forest Service. Howard E. Ahlskog has been named his successor. Announced plans called for transfer of Mr. Ahlskog from the position of supervisor of the Kootenai National Forest, Libby, Mont.

Education

North Carolina to Offer Merchandising Course

Establishment of a new four-year course in Lumber and Building Materials Merchandising was recently announced by the School of Forestry at North Carolina State College.

In making the announcement, Dr. Richard J. Preston, dean of the School of Forestry, and Prof. Roy M. Carter, head of the Wood Technology Curriculum, said the course was set up in response to industrial needs for highly-trained personnel.

Graduates, they said, will have a broad background of training in business methods, administration, sales, distribution, marketing, and the technology of products and materials used in structures and construction work.

Students will be enrolled in the new curriculum during the fall semester starting in September 1958.

North Carolina State College is the fifth school in the nation to inaugurate such a training program. Other institutions previously establishing courses are Michigan State University, New York State College of Forestry, the University of Minnesota, and the University of Missouri.

Yale Acquires Graves Papers

The personal papers of the late Henry S. Graves, first dean of the Yale School of Forestry and a pioneer in American forestry, have been acquired by the Yale University Library.

These papers, which include his diaries, provide a major documentary source about people and events in the administration of the U. S. Forest Service from 1910 to 1920 when he was chief forester.

The diaries of the Yale Dean, in which he often expressed his most personal opinions on controversial subjects, cannot be published, although they are available for purposes of documentation.

Dean Graves' papers were donated to the library by his widow, Mrs. Henry S. Graves, it was announced by George A. Garratt, dean of the Yale School of Forestry.

Engineer Joins Michigan State Staff

Appointment of Mr. Byron M. Radcliffe as an associate professor has been announced by Alexis J. Panshin, head of the Department of Forest Products at Michigan State University. He will supervise the Residential Building curriculum with an enrollment of 150 undergraduate students.

Mr. Radcliffe was previously director of engineering and research, Place & Company, South Bend, Ind. Prior to that he was director of the Wood Research Laboratory at Purdue University. He is an engineering graduate of Purdue.

Allied

FPRS Announces Executive Office Building Plans

Construction of a new national executive office for the Forest Products Research Society was started at Madison, Wis., in late December, according to Frank J. Rovsek, executive secretary of the 3,800 member organization.

The new office building will embody many new forest products materials and techniques designed to demonstrate the precision and elegance of fine workmanship inherent in forest products as structural and decorative materials. One of the outstanding features will be its cantilevered exterior design. Laminated wood post and beam design will constitute one of the principal architectural features of the building.

The building will be situated just a block from the U. S. Forest Products Laboratory, with which the Society is closely associated and draws on for technical assistance.

A 30- by 50-foot structure, the building will have offices on two levels, providing a total working area of 3,000 square feet. Its design allows for expansion, and the unit is expected to be valued in excess of $60,000 when the initial construction is completed. Completion is expected to take place in time for the Society's 12th National Meeting at Madison, Wis., June 22-27, 1958, at which time the building will be dedicated.

A unique aspect of the building program is that almost all of the building materials and funds are being contributed by member companies and individuals. The materials and fund-raising program had in January reached a total of $40,000 toward the goal of $60,000.

Heads Range Management Society

Dr. R. S. Campbell has been elected president of the American Society of Range Management for 1958. The Society is a scientific organization for advancing the intelligent management and use of range and pasture lands

R. S. CAMPBELL

and related resources of soil and water. Its purposes are to assist ranchers, teachers, and grassland technicians to keep abreast of new methods and new forage plants, and to create public appreciation of range resources both nationally and internationally.

The Society was organized in 1947 and is the only American scientific organization devoted solely to sustained yields of grasslands and sound grazing management. It has more than 3,000 members, mostly from the western United States, but with good representation from the South and from several foreign countries.

Dr. Campbell is chief, Division of Range and Watershed Management Research of the Southern Forest Experiment Station. His headquarters are in New Orleans. Since he joined the station in 1943, he has made extensive studies of forest range grazing and range livestock production in the Deep South. He has written many bulletins and articles on the subject, several of which have been published in cooperation with the Louisiana Agricultural Experiment Station and the Louisiana Forestry Commission.

Dr. Campbell was editor of the *Journal of Range Management* for three years, and served as vice president of the Society in 1957.

Canada Host to World Congress of Botanists

The Ninth International Botanical Congress will be held August 19-29, 1959, at Montreal, Canada.

The ten-day meeting will be one of the biggest scientific gatherings ever to take place in Canada. Some 4,000 participants are expected from all parts of the world.

Dr. W. P. Thompson, president of the University of Saskatchewan, has been named president of the Congress.

The University of Montreal and McGill University will share in the honor of entertaining the Congress.

TREE FARM MANAGEMENT SERVICE
1166-7th Avenue, West, Eugene, Oregon
Protection—Reforestation—Inventory
Utilization—Research
Verne D. Bronson, Chief forester, Phone 5-5371

Reforestation Arboriculture
S. GAYLEY ATKINSON
Consulting Forester
Huntingdon Road
Huntingdon Valley, Pa.

FOREST PROPERTY
Estimates—Appraisals—Management
Prentiss & Carlisle Co., Inc.
107 Court Street Bangor, Maine

FOREST MANAGEMENT
Topographic Mapping
Timber Stand Maps
Land Classification
Forest Development Studies
Forest Inventories
Forest Appraisals
Hammon, Jensen & Wallen
MAPPING AND FORESTRY SERVICES
660 HEGENBERGER ROAD OAKLAND 21, CALIFORNIA
General Photogrammetric and Forestry Consulting Services

INDEX TO ADVERTISERS

	page
Adirondack Forestry, Inc.	254
Atkinson, S. Gayley	255
Banzhaf, George & Co.	252
Bartlett Mfg. Co.	238
Belanger & Bourget	252
Bozett, William J.	253
Brady, Joe H. Assoc.	234
Capital Forestry Co., Inc.	252
Caterpillar Tractor Co.	239
Clark, Thomas G.	254
Clifton, Thomas C.	254
Crank, Porcius F. Jr.	253
Cranston, Keith	252
Deere & Co.	229
Dow Chemical Co.	231
Eastman, Wm. A. Jr.	254
Fechheimer Bros. Co.	247
Finco, Inc.	242
Fire Fighting Films	251
Forest Seeds of Calif.	246
Forestry Suppliers, Inc.	243
Guthrie, John G.	253
Hale Fire Pump Co.	245
Hall, Albert G.	254
Hammon, Jensen & Wallen	255
Homelite	Back Cover
International Harvester	249, 3rd Cover
Keene Forestry Assn.	251
Knoth, Robert F. & Co.	253
Koppers Co., Inc.	237
Kurfew, Inc.	247
Lemieux, Frank J.	254
Lind, A. L. Co.	246
Lowther, Harry A. Co.	250
Mall Tool Co.	233
Mann Edge Tool Co.	248
Meadows, Ben.	232
Mechanical Transplanter Co.	247
Motorola	178
Musser Forests	236
National Agricultural Supply Co.	236
Nelson Co.	250
Northern Tree Co.	253
Osmose Wood Preserving Co.	244
Pacific Weather Service	251
Paint Creek Nurseries	251
Panama Pump Co.	230
Pomeroy & McGowin	252
Pond & Moyer	253
Prentiss & Carlisle	255
Price, Wm. H.	254
Rich, C. H. Forest Fire Tool Co.	251
Ronald Press Co.	241
Rootspred Tree Planter	244
Sanders, Paul M.	253
Sandvik Steel Co.	242
Sebrell, J. B. Corp.	246
Sewall, James W.	252
Shannon, R. B. & Assoc.	253
Silva, Inc.	246
Smith, D. B. Co.	2nd Cover
Southern Coatings	240
Southern Seed Co.	247
Stock, John W.	254
Stratex Instrument Co.	238
Timber Mgmt. Service	254
Tree Farm Mgmt. Service	255
Utility Tool & Body Co.	246
Western Fire Equipment Co.	232
Weyerhaeuser Timber Co.	235
Winslow, Paul T.	253

Products & Equipment

New John Deere Equipment

Two new tractors—a crawler and a wheel-type—and several new major items of matched working equipment, all designed and built for industrial uses, are announced by the John Deere Industrial Division, Moline, Ill. They are now on display at John Deere dealerships throughout the U. S. and Canada.

Eye appeal and ruggedness of construction are evident in the 440 Series Tractors and in the new protective front grille and extra-heavy cast grille frame, which requires no extra guard. Room is provided between the grille and the engine on the new Crawler for front-mounted, crankshaft-driven pumps.

The 440 Crawler is mounted on two heavy steel cross members that absorb shocks and stresses from front-mounted equipment such as loaders and bulldozers. Strength and durability are designed into the power train and track essemblies of the crawler.

The 440 Wheel-Type tractor has a new heavy-duty front axle and support. Built-in power steering for this model is optional.

New Tree Girdler

Joe H. Brady and Associates, of Birmingham, Ala., one of the South's oldest and largest chain saw distributors, announces the production of a new manually operated tree girdler.

The precision-made tool weighs only 2½ pounds and can easily be carried in the hip pocket. It consists of a 33-inch length of specially designed cutting chain with hand-molded grips at each end. The Brady girdler is designed effectively to girdle an average 4-6 inch cull hardwood trees, including hickory, in less than 20 seconds.

The following information is given by the company: the tool is simple in operation and has 26 tempered chrome cutting teeth which are exactingly arranged to provide fast, sure, and safe use with the very minimum of effort.

Large cutting teeth start the groove easily. Eight inches of double chain at each end widen the kerf and then a single chain section moves freely and quickly to complete the job while the user has to work only half way round the tree to get a complete girdle.

Forestry Employment

Positions Wanted

Forester, B.S.F., 1952, M.S.F., 1953, Univ. of Mich. M.B.A. (General Business) 1958, Univ. of Wash. Age 28, married, 2 children. Part time forestry experience includes photogrametry, veneer mill, and some woods experience. Presently teaching NROTC at large university. Being released from Navy June 1958. Desire position in private forestry or teaching. Interested in Northeast or Lake States, but no restrictions.
Box C, Journal of Forestry, Mills Building, Washington 6, D.C.

Forester, graduate Yale M.F. 1954. Age 26, single. Experience since 1954 with U.S.F.S. in Northwest in protection, planting, cruising, timber appraisal, forest inventory, and forest management. Also minor experience previously in Northeast. Detailed summary of experience upon request. Interested in teaching or challenging position with medium-sized organization in field of forest management.
Box D, Journal of Forestry, Mills Building, Washington 6, D.C.

Forester, B.S.F., University of Idaho, 1954. Age 28, single, veteran. Presently employed in farm forestry work with state agency. Experience in fire control, timber management, and recreation, 4 summers experience U.S.F.S. Desire employment in Western United States, but will consider other locations.
Box E, Journal of Forestry, Mills Building, Washington 6, D. C.

Forester, B.S.F., Michigan State College 1951. Age 31, single. Six years previous experience in forest land management, forest products research and personnel management with private industry and federal government. Desire position with progressive private industry. Will consider any position related to forestry. Resumé available upon request.
Box F, Journal of Forestry, Mills Building, Washington 6, D. C.

Forest entomologist, Ph.D. Age 35, married, 3 children. Experience: forest entomologist, U. S. Dept. Agric.; four years university teaching and research; publications. Desire research and/or research and teaching (emphasis on research opportunities). U. S. or Latin America.
Box G, Journal of Forestry, Mills Building, Washington 6, D. C.

Forester, B.S.F., 1954. Age 29, married, 3 children. Seeking forest management position, preferably in Piedmont Region. Four years experience with pulp and paper industry in Southeast. Three years as company forester in management field, and one year as timber cruiser and buyer for wood dealer. Experienced in timber and land management, cruising, fire control, planting and reforestation timber sales, land acquisition and surveying.
Box I, Journal of Forestry, Mills Building, Washington 6, D. C.

Forester, B.S., Forest Management, 1954 and M.S., Forest Management (Economics), 1958, Colorado State University. Age 25, married, no children. Ordnance maintenance shop officer, U. S. Army two years. Experience in forest management, utilization, marketing research, lumber grade recovery studies, teaching, and operation and programing of machine computational equipment (IBM). Experience is in the Rocky Mountain Region.
Box L, Journal of Forestry, Mills Building, Washington 6, D. C.

B. S. in Forestry, June 1958. Would like employment in Arkansas-Missouri area; will consider other locations. Age 30, have a family.
Box J, Journal of Forestry, Mills Building, Washington 6, D. C.

Forester, B.S.F., 1956, Univ. of Missouri. Age 24, single. Will complete two years of active Army duty the latter part of June. Summer experience in forest inventory and surveying in both eastern Tennessee and central Arkansas, plus three months of fire control in Missouri before entering Army. Desire position in private industry offering advancement opportunities. Southeastern states preferred, but other regions considered.
Box K, Journal of Forestry, Mills Building, Washington 6, D. C.

greater skidding power!

because it's a half-ton more tractor!

Up to 1,000 pounds greater built-in strength and traction weight than other tractors in the 45 hp class is one reason why the International® 350 Utility logging tractor gives you greater log-skidding power on turns, on the straight-aways, in mud, for short or long hauls. Greater traction for bigger loads, greater stamina to cut maintenance costs—both are reasons why you can count on the International 350 Utility to boost logging profits.

Work-speeding, time-saving options include integral power steering that doesn't "kick back" on rutted woods roads. Torque Amplifier drive with 10 speeds forward provides up to 45 per cent greater pull-power for quicker starts with heavy logs deep in the woods . . . then steps up speed, *on the go*, in any gear, without shifting!

Averages well over 300 bf per haul, reports R. D. Jones, Lacy, Ark., of his three International 350 Utility tractors equipped with half-tracks. Exclusive front bolster design makes it easy to attach locally-made pan guard and bumper.

Ask your IH Dealer to demonstrate these features that make the 350 Utility logging tractor head of the 45 hp class! Also, ask about the new International 330 Utility for greater strength and stamina in the economical 35 hp class. There's an IH dealer near you—Call him today!

SEE YOUR INTERNATIONAL HARVESTER® DEALER

Now you can get a heavy-duty tractor in the economical 35 hp class! It's the new International 330 Utility with all the optional features of the bigger 350 Utility.

International Harvester Products *pay for themselves in use*—Farm Tractors and Equipment . . . Twine . . . Commercial Wheel Tractors . . . Motor Trucks . . . Construction Equipment—General Office, Chicago 1, Illinois

Make more money with Homelite

This man is making more money with a Homelite 6-22 chain saw. It cuts so fast that he can buck a 20-inch log in 18 seconds, fell trees up to seven feet in diameter. One of four Homelite models, the 6-22 is a good example of the plus value you get with Homelite:

you get speed and power thanks to a revolutionary, new intake valve, positive-action fuel pump and diaphragm carburetor. The 6-22 packs 6 full horsepower into only 22* pounds.

you get light weight that's easy to handle all day long with less fatigue in even the roughest terrain. Balanced design lets you cut easily and smoothly in any position, any type cut.

you get dependability with famous Homelite short-stroke, high-compression engine that stands up under the grind. Maintenance and down-time are lower, too. Homelite design increases engine life, cuts gas consumption.

you get fast service from the Homelite dealer near you. He's factory-trained and stocks spare parts for quick service.

Prove to yourself that Homelite chain saws cut 5% faster than any other saws in their horsepower class. Have a free demonstration today.

As Little as $4.87 Weekly
after small down payment

Homelite's quick, easy finance plan lets you buy now, pay in small weekly installments out of the money you earn with your new Homelite chain saw.

HOMELITE
A DIVISION OF TEXTRON INC.
4103 RIVERDALE AVE., PORT CHESTER, NEW YORK
Canadian Distributors: Terry Machinery Co., Ltd.

TRY ALL FOUR—CHOOSE THE ONE THAT SUITS YOU BEST

4 HORSEPOWER

Model 4-20, cuts trees up to 4 feet in diameter. 4 horsepower, 20* pounds. Rugged gear drive gives you consistent, dependable performance

6 HORSEPOW

Model EZ-6, fo
est-cutting direct dr
chain saw. 6 hor
power, 19* poun
Fells trees up to 5 fe
in diameter. Powerf
light weight, precisi
built.

6 HORSEPOWER

Model 6-22, most versatile gear-drive chain saw. 6 horsepower, 22* pounds. Cuts trees up to 7 feet in diameter, choice of straight blade and plunge cut bow, brush cutting and clearing attachments.

7 HORSEPOWE

Model 7-29, mo
powerful one-man cha
saw you can own.
horsepower, 29* pound
belt drive. Fells trees u
to 10 feet in diameter.

*Less bar and chain.

THE
EST

SEPOWE
Z-6, fo
direct dr
6 hor
9" poun
p to 5 fe
r. Powerf
, precisio

SEPOWE
29, mo
e-man cha
an own.
29" pound
ells trees u
diameter.

d chain.